



SIR RONALD ROSS
MALARIA TRANSMISSION CENTENARY CELEBRATIONS

**THIRD NATIONAL SEMINAR ON
MALARIA**

&

OTHER TROPICAL DISEASES

February 18-20, 1997

SOUVENIR & ABSTRACTS

BANGALORE



UNIVERSITY



SOCIETY FOR APPLIED GENETICS

Centre for Applied Genetics,
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THIRD NATIONAL SEMINAR ON MALARIA & OTHER TROPICAL DISEASES

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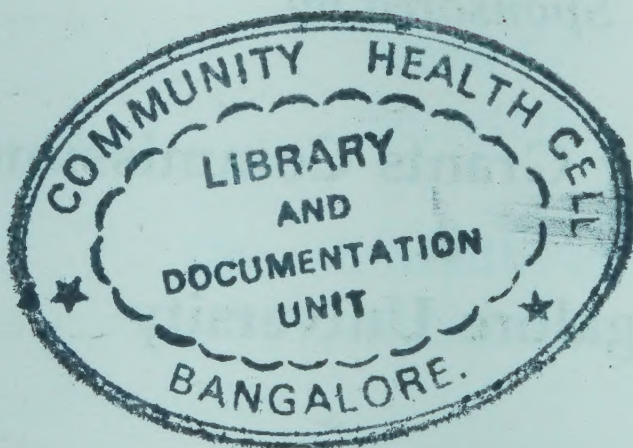
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Preface

This year the world of tropical medicine honours one of its great men, Nobel Laureate Sir Ronald Ross, who 100 years ago (1897) discovered the transmission of MALARIA by the female *Anopheles* mosquito. In order to commemorate this discovery, we are organising a three day "National Seminar on Malaria & other Tropical Diseases", from February 18-20, 1997 under the auspices of Society for Applied Genetics, Centre for Applied Genetics, Bangalore University.

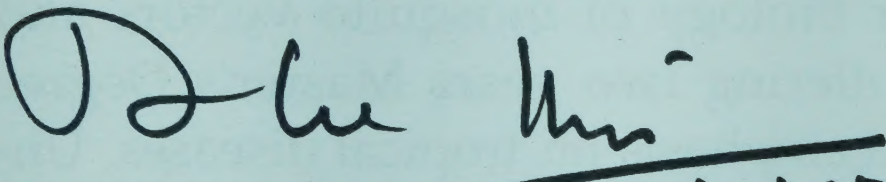
The Centre for Applied Genetics located at the Jnanabharathi Campus, Bangalore University, has been conducting research in the areas of formal genetics, genetic basis of insecticide resistances, cytogenetic studies, biochemical genetics, chromosomal aberrations, especially translocations and preferential elimination of females, molecular biology of mosquito vectors and malariology. The said Centre is also offering two years Master's Degree course in Applied Genetics with special emphasis on tropical diseases. Under its auspices, the Society for Applied Genetics was established during 1995 to carry out the academic activities, including conducting of Lectures, National Seminars, Workshops etc.

The tropical diseases including mosquito borne diseases are increasing day by day to such an extent that a major portion of the National health budget is spent on controlling these diseases. In order to control these diseases, either the parasites or the insect vectors should be controlled. It is generally believed that vector control is more appropriate than that of the parasites. It is also important to mention here that organised research in the area of vector biology is very much required. Therefore, it is necessary that this type of research should be undertaken at the University level and public health Departments including national Laboratories. At this juncture it was strongly felt that conducting a National Seminar would be appropriate. This would provide scientists, public health workers, policy makers, Government and non-Government agencies and Universities, a forum for interaction, exchanging latest knowledge and information regarding the control of tropical diseases. This would also enable us to discuss and reach common strategies regarding control of the above said diseases. In view of this, it is

proposed to organise the national seminar of this kind.

We have received nearly 125 abstracts of the papers. This includes ninety two abstracts on tropical diseases and thirty three on applied entomology. Twenty one plenary/invited lectures by eminent scientists have been arranged in the area of tropical diseases, medical biotechnology, pest management etc.

As an outcome of this National Seminar, it is hoped that suitable recommendations will be made for proper implementation of vector control programmes both at the State and National level. It is also hoped that the deliberations would go a long way in conducting research in an organised way and also to inspire younger generations to take up an advanced research in the area of tropical diseases especially malariology.


 Prof. N.J. Shetty
 Organising Secretary

5/2/97



Colonel **SIR RONALD ROSS**, KCB, KCMG, FRS, LL.D., M.D., DSc, FRCS,
DPH, LSA.

(Source: London School of Hygiene & Tropical Medicine, London)

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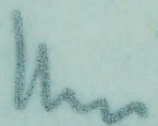
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D.P.H., L.S.A.

(Source: London School of Hygiene & Tropical Medicine, London)

Sir Ronald Ross

(1857-1932)

Nobel Laureate Sir Ronald Ross's pioneering discovery on the mechanism of malaria transmission by the female Anopheline mosquito, 100 years back, has been considered as an outstanding contribution to the field of Tropical Medicine and as a mark of respect to him, we celebrate this year as the "Centenary Year" for his glorious contribution.

Sir Ronald Ross was born on May 13, 1857 at Almora in the Himalayas, India, three days after the outbreak of the Great Indian Mutiny and hence called himself as "Mutiny Baby". Ross was a person who towered above his fellowmen in his genius, patience and high moral courage. He descended from a family who had served with great distinction in India. His father, General Sir Campbell Claye Grant Ross, K.C.B., was a Commander-in-Chief of the Afghan Frontier. He was a lover of Indian art, culture and heritage, and left many delightful water colour sketches of Indian scenario. Despite artistic inclinations, he insisted on Ross to study medicine at St. Bartholomew's Hospital. After a protracted career as a reluctant medical student and a brief one as a ship's surgeon, he completed his qualification in 1881 and joined the Indian Medical Service at Madras.

After serving in various parts of Madras Presidency, Burma and Andaman Islands, he became interested in the studies of Malaria. It was the sufferings in the wards of his Indian Hospital that brought out the greatness of this Great Man. So, in 1889 he went to London to study the new science of Bacteriology and working for the newly created Diploma of Public Health and returned to India in 1892 with a determination to combat Malaria. Being a hasty researcher, he could find nothing special on pricking Malariacs for the blood and examining under the microscope. He therefore thought Malaria was caused by intestinal disturbances.

Frustrated, Ross returned to England to give up medicine, where he came into contact with Sir Patrick Manson, who has been acclaimed the "Father of Modern Tropical Medicine". Manson placed all his knowledge of Malaria at Ross's disposal and remained his most constant friend and guide.

Ross arrived in India at Bombay on April 21, 1895 and on 24th at Secunderabad, determined to follow the line of research suggested by Manson, whenever regimental duties permitted. He captured mosquitoes, let them loose inside the beds of Malariacs, collected the blood-fed flies in bottles and examined blood to spot the crescent shaped *Protozoa* growing, but failed. He did not use stains, but worked throughout on living parasites and freshly dissected insects.

Early September, 1895, Ross was ordered to go to Bangalore on special sanitary duty of importance which occupied him for 18 months. This checked his malarial work. On June 18th 1897, he arrived again at Secunderabad and resumed his malaria work with renewed vigor. Ross entered into an agreement with a patient Mr. Hussein Khan who agreed for the bites, confined in a net for a few chips, by the grey mosquitoes as Ross used to describe *Anopheles*. As in his previous experiments, the replete female insects were each isolated in cotton plugged tubes but he delayed their dissection until an interval of four days had elapsed. On August 20, 1897, (Commemorated by Ross as his Mosquito Day) he examined an *Anopheles* that had sucked the blood containing crescents four days previously and found 'Pigmented Cysts' in the insects gut wall. A second *Anopheles* dissected on the fifth day harboured larger cysts. At last, goal was in sight.

Working under trying conditions and full pressure without any encouragement except for Manson's letter, Ross inched towards success. In the midst of final experiment, he was ordered to go to Khewara in Rajputana on military service, a place over a thousand miles away, where there was no malaria and little of importance to do. This situation was exasperating. It was not until February 17, 1898 that Ross was able to reach Calcutta and resume work on Malaria.

While working with his assistant Mohamed Bux, Ross got the idea that since birds too suffered from malaria, they could also be used for research. They caught sparrows, larks and crows, but later preferred to work with sparrows. He made numerous positive infection experiments with birds using mosquitoes. He observed that the blood sucked from the mildly affected birds contained only few parasites in circles. These circles multiplied in the

stomach cells of female mosquitoes and moved towards the cell wall and burst out on the 7th day. The spindle shaped germs then swarmed towards the mosquito's stinger to be passed on to the other birds and humans whom they bite, thus causing malaria. These results constitute the classical demonstration of how malaria is conveyed. He repeated the results and concluded that it is the mosquitoes that carried malaria parasite and one does not get it by drinking water as perceived by Manson.

Among the difficulties encountered by Ross at this period, was getting Malariacs who would allow themselves to be pricked for a drop or two of blood for observation. None came forward because it was rumored among the ignorant population that they were being inoculated with Plague. Circumstances therefore compelled Ross to confine his work almost entirely to "Avian Malaria".

Ross's discovery marked the beginning of new era in tropical medicine and he devoted his life to applying the results of it. Manson believed that what was true for birds must also be true for humans and asked Ross to prove it. But Ross could not do it, perhaps having crossed the limits of persistence and left it for an Italian Professor, Giovanni Battista Grassi.

The result of work were announced by Manson to the Tropical Medicine section of British Medical Association at Edinburgh on July 24, 1898. The discovery was important not only because it showed how malaria spreads, but also for other men to investigate insects as the carriers of other diseases. Within a few years, the germs of yellow fever, relapsing fever, plague, typhus fever, sleeping sickness had all been shown to have insect hosts. Thus, a fundamental discovery opened wide the flood gates of knowledge. Ross was now filled with an equal devotion to the cause of preventing the disease.

On leaving India, Ross became Professor of Tropical Medicine at the Liverpool School of Tropical Medicine, England and he threw himself whole heartedly into the work. He left Liverpool in 1913 and began consulting work in London and was building up a large practice when the Great war claimed his services as consultant on Malaria to the war office. After the war, he was consultant in Tropical Diseases to Ministry of Pensions, but his health was not good. Later, he became the Director-in-Chief of Ross Institute and

Hospital for Tropical Diseases in London, with the design of making it a centre of treatment and research. The Institute was opened by Prince of Wales in July 1926. On behalf of the Institute, Ross visited Ceylon in 1925 and Malaya and India in 1926-27. This was his last expedition to the Tropics, for at the end of 1927 he became paralysed on his left side. He had become the Editor of 'Science Progress' in 1930 and 'Annals of Tropical Medicine' and remained Editor till his death (1932).

In 1902, Ross received one of the earliest Nobel prize and a few years later a Royal Medal from the Royal Society. Academic honours came to him from all over the world. He was made a Knight Commander of the Bath (England) in 1911, and Knight Commander of St. Michael and St. George in 1918.

A visit to Malaya in 1926 may be regarded as turning point in his thoughts, while most of the world had failed to use the knowledge he had given them, Malaya had forged ahead, quietly and steadily, since 1901. The success at Klang and Port Swettenham had shown what could be done and he was happy that they had saved the honour of the British people for scientific practical work. He saw the same kind of success in Singapore also.

Although to the outside world, Ross was a critic, a satirist and the fighter, he was in fact a kindly, genial and generous man. He was particularly kind to young men and returned in full measure to help them. Honest himself, he expected it in others, and he was sometimes the victim of knaves. He was an extra ordinary man, for he made himself famous as a poet, was an eminent Mathematician, clever painter and a skilled musician. In 1883-1929, he published several plays, short dramas, romances, fables and numerous poems. His paper on mathematics, various medical reports and papers dealing with his outstanding work in relation to malaria, are mostly comprised in a list at the end of his 'Memoirs'.

Ross married in 1889 Miss Rosa Bloxam, who proved to be a devoted wife and shared with him the early and difficult years in India. They had two sons and two daughters. The death of his wife in September 1931 was a heavy blow under which he slowly sank. After her death, he came to live at the Ross Institute, where he received devoted attention and loving care from

Miss Gray, the Matron, and the other members of the nursing staff.

He was patient in pain---happily in the last few weeks there was almost none, only increasing weakness. But despite his weakness there was the same solicitude for the happiness of others that had guided his life.

He died at the Ross Institute on Friday, September 16, 1932 and few days later was buried, according to his wish, beside his wife at the Putney Hill Cemetery. He has left behind a glorious legacy and the message ---- "There is so much to do where it looks as if there is nothing to do".

In view of this phenomenal and sensational discovery made by Sir Ronald Ross on the transmission of malaria by female *Anopheles* mosquitoes, in the history of Tropical Medicine, it was felt that by organising a 'National Seminar on Malaria & other Tropical Diseases', which marks the centenary year of this remarkable discovery, is the befitting way of paying tributes to this great man. It is also hoped that this is the best way to create awareness among people about Tropical Diseases.

Prof. N.J. SHETTY

Director, Centre of Applied Genetics, Bangalore University

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Organizing Secretary, Third National Seminar on Malaria & other Tropical Diseases (February 18-20, 1997)

Programme

Tuesday - February 18, 1997

08.00 Hrs.	Registration
09.30 Hrs.	Inauguration
11.00 Hrs.	Inaugural TEA
11.15 Hrs.	Special Scientific Session
11.45 Hrs.	Scientific Session I
12.25 Hrs.	Scientific Session II
13.30 Hrs.	LUNCH
14.30 Hrs.	Scientific Session III
16.00 Hrs.	Scientific Session IV
17.40 Hrs.	TEA
18.00 Hrs.	AT HOME
19.30 Hrs.	DINNER

Wednesday - February 19, 1997

08.30 Hrs.	Scientific Session V
09.20 Hrs.	Scientific Session VI
10.40 Hrs.	TEA/COFFEE
11.00 Hrs.	Scientific Session VII
12.30 Hrs.	Scientific Session VIII
13.30 Hrs.	LUNCH
14.30 Hrs.	Scientific Session IX
15.40 Hrs.	TEA
16.00 Hrs.	Scientific Session X
19.30 Hrs.	DINNER

Thursday - February 20, 1997

08.30 Hrs.	Scientific Session XI
09.50 Hrs.	Scientific Session XII
11.00 Hrs.	TEA/COFFEE
11.20 Hrs.	Scientific Session XIII
11.35 Hrs.	Poster Session
13.00 Hrs.	LUNCH
14.15 Hrs.	Poster Session-continuation
15.30 Hrs.	Concluding Session/Valedictory Function
17.00 Hrs.	High TEA

PLENARY / INVITED LECTURES

Newer Drug Targets in the Malarial Parasite ✓

Padmanaban G.

Department of Biochemistry, Indian Institute of Science, Bangalore 560 012

The development of chloroquine resistance in the malarial parasite has called for the development of newer drug targets. The unique properties of Hypoxanthine-Guanosine phosphoribosyl transferase (HGPRT) of the malarial parasite has led its cloning and expression and is being used for screening against potential antimalarials. A second important finding in this laboratory has been the demonstration that the parasite requires heme for growth and protein synthesis and it synthesizes heme *de novo* despite the availability of large amounts of heme derived from the host red cell haemoglobin. Inhibition of the *de novo* biosynthetic pathway of heme leads to the death of the parasites. Interestingly, the parasite appears to import most of the enzymes of the pathway from the host red cell. There is clear evidence for the parasitic origin of only one of the enzymes involved, namely δ -aminolevulinate (ALA) synthase. All other enzymes are strikingly induced in the host (mice) red cell as a result of the parasite (*P. berghei*) infection and a quantity imported into the parasite most likely involving a receptor. Thus ALA synthase and the receptor would constitute unique parasite targets for the development of new antimalarials. Studies also reveal that one of the major mechanisms of chloroquine action is to inhibit heme-dependent protein synthesis in the parasite. Thus, inhibitors of heme synthesis may also help to overcome chloroquine resistance. Other targets to develop antimalarials include hemoglobin degradation, hemozoin formation and enzymes of the glycolytic cycle.

Emerging and Re-emerging Parasitic Diseases

Mahajan R.C.

Professor & Head, Departments of Parasitology & Virology & Chairman, Microbiology, Postgraduate Institute of Medical Education & Research, Chandigarh 160 012

According to Prof. V. Ramalingaswami, in India, the health history in infectious diseases has been a mixed one - comprising of various successes and failures. The major problem for India, has been the sustainability of those successes and overcoming the inertia and complacency following initial successes. With increasing population, urbanisation, industrialisation, poor sanitation, deforestation, unplanned reforestation, climatic changes, some diseases which were previously unrecognised are emerging. Erratic eating habits, poverty and environmental degradation have also led to the emergence of food borne parasitic zoonoses (mostly Trematodes and Nematodes) till recently unknown as a major future health problem. The adverse impact of all round deterioration in the ecology and environment, development of antimicrobial/insecticide resistance, and increased population mobility have resulted in the magnitude of vector borne diseases like malaria, lymphatic filariasis, visceral leishmaniasis and babesiosis, posing a serious challenge to the overburdened national health care delivery system.

For control of these emerging and re-emerging diseases, proper surveillance of the factors influencing their emergence, detection, investigation and monitoring of these pathogens is required. In addition, integration of laboratory science and epidemiology, proper health education with better community participation, easy availability of specific chemo-therapeutic agents; effective vaccine development and prompt implementation of prevention strategies is required.

Drug Resistant Malaria in India

Sharma V.P.

Malaria Research Centre, 22-Sham Nath Marg, Delhi 110 054

Chloroquine is the first line of drug to treat a case of malaria. For the first time in 1973 resistance to chloroquine was reported from Diphu and Nowgong in Assam. As a result a regular drug resistance monitoring programme was set up under the National Malaria Eradication Programme. In subsequent years drug resistant *P. falciparum* strains spread rapidly west wards and covered the entire country. In areas with high levels of resistance (RII and RIII), long acting sulpha drugs were introduced. In less than a decade there were reports of resistance to sulpha drugs. In 1996 there were two independent reports of the resistance in *P. vivax* to chloroquine. Since there is no regular monitoring of resistance in *P. vivax*, it is likely that this problem is more widespread. Resistance in *P. vivax* is compounded by relapses, resistance to primaquine and the fact that sulpha drugs are not effective in the treatment of *vivax* malaria. Furthermore, drug resistant parasites are spreading through the insecticide resistant vectors resulting in a rising trend of morbidity and mortality. The problem of drug resistant malaria is a formidable challenge to the success of malaria control programme and this problem is emerging as a major concern of public health departments. Long term planning of vector control through biological and environmental management methods supplemented by selective use of insecticides and supported by rapid diagnostics, new drugs and drug combinations is required to bring malaria under control.

✓ Diagnosis and Immunomonitoring of Filarial Infection with Microfilarial ES Antigens

Harinath B.C.

Department of Biochemistry & JBTDR, MGIMS, Sevagram 442 102

Bancroftian filariasis is a major public health problem in India with about 44 million people either harbouring microfilariae or suffering with filarial disease manifestations. ELISA using microfilarial ES antigen for detecting IgG antibody by Indirect ELISA and antigen by Inhibition ELISA has been explored in monitoring carriers as well as clinical filarial cases. A ten year follow up study was done on immune status during therapy and recurrence of infection if any in 27 microfilaraemic patients in an endemic area. One full course of DEC treatment (75 mg kg^{-1} body wt.) followed by one yearly dose (6 mg kg^{-1} body wt.) showed disappearance of microfilaraemia in most of the cases excepting for the two cases at the end of ten years. There was disappearance of antigen and antibody followed by gradual increase in antigen and antibody levels in a few cases during the course of ten years. None of the cases followed in this study developed any clinical symptoms suggesting the need for long term monitoring and treatment of microfilaraemic patients in an endemic area to interrupt transmission and prevent clinical manifestations. Further, this immunoassay system was found to be useful in confirming filarial aetiology in the absence of microfilaraemia and monitoring of acute, early clinical and occult filarial infections such as lymphodema, hydrocele, epididymoorchitis, lymphadenopathy, tropical pulmonary eosinophilia, monoarthritis, central serous retinopathy etc. with long term DEC therapy (6 mg kg^{-1} for 21 days in a month) for as long as 12 months showed considerable relief/cure in clinical manifestations due to filarial infection.

Vector-Borne Diseases and their Control

Das P.K.

Vector Control Research Centre, Pondicherry 605 006

Vector-borne diseases like Malaria, Filariasis, Japanese Encephalitis, Dengue, Plague etc., are emerging as major causes of sickness, incapacitation, disfigurement and death. This is mainly due to explosive population growth, unplanned urbanization and a fall out of industrialization. In addition various developmental activities implemented to provide better shelter, water, air, nutrition, create ideal environment for proliferation of all vector-borne diseases.

Control efforts undertaken from time to time as fire fighting measures had little impact, because of inappropriate use of existing tools. Utilization of tools and technology currently available in right time and right place can substantially reduce the disease burden. Developing surveillance and monitoring system and environmental improvement to prevent vector breeding should be given top priority.

Sustainable reduction of vector-borne diseases can be achieved by integrated approach with community involvement. This could be done only if site specific control strategies are designed rather than following global strategies.

A New Approach to Control Malaria

Shetty N.J.

*Centre for Applied Genetics, Bangalore University, Jnanabharathi Campus,
Bangalore 560 056*

The challenge posed by insecticide resistance in mosquitoes has resulted in greater interest in mosquito genetics which has become one of the most rapidly growing areas of medical entomology. Resistance, with its genetic basis, has underlined the need for intensive genetic and cytogenetic research, especially on malaria vectors.

The replacement of wild mosquito populations with genetically defined lines of vector mosquitoes, refractory to the development of the malarial parasite is one possible method for controlling malaria. The refractory mosquito population would be incapable of transmitting the infection. In addition to this, there are certain chromosomal aberrations especially translocations and pericentric inversions associated with high levels of sterility and are potentially useful for genetic control measures. In order to achieve the genetic manipulation involving sterile males, releases can be enhanced by developing a method by which males can be easily separated from the females during mass production. Therefore, genetic sexing system for preferential elimination of females during early developmental stages is mandatory. The relevance of vector genetics and the role of genetics in vector control will be presented and the future prospects will also be discussed

Techniques in Malarial Entomology: Progress and Prospects

Sarala K. Subbarao

Malaria Research Centre (ICMR), Delhi 110 054

Sir Ronald Ross's discovery of malaria parasite in the gut of a mosquito in 1897 had for the first time established the role of the mosquito in the transmission of malaria. Since then several techniques have been developed to monitor effectively anopheline populations for understanding and controlling disease transmission. The parameters which are generally monitored in malaria control programmes are species identification, composition and prevalence; feeding preferences and rhythms; vectorial capacity/potential; longevity and survival rates; and responses to control measures.

Techniques for the identification of mosquitoes have come a long way since Ross's discovery when no morphological keys were available in contrast to today when computer based keys have been developed. And, with the presence of species complexes comprising morphologically indistinguishable sibling species within anopheline taxa, there is a need to use genetic methods which demonstrate reproductive isolation, and to develop simple and efficient tools for the routine identification of sibling species. To achieve this, cytogenetic, biochemical and molecular approaches are being used. Further, biochemical, immunological and molecular techniques are being applied to vector incrimination, mosquito blood meal analysis, insecticide resistance monitoring etc. The status and the scope of these techniques in malaria control programmes will be presented and future prospects will be discussed.

Strategies in Genetic Improvement of *Bacillus thuringiensis* based Bioinsecticides

Xavier R., Kathirvel V., Shanmugavelu U., Sachidanandham R. and
Kunthala Jayaraman

Centre for Biotechnology, Anna University, Madras 600 025

Biopesticides based on strains of *Bacilli* have been used successfully for more than two decades without substantial resistance development to the target pests. However, it has been demonstrated with laboratory selection experiments that resistance development could be induced upon prolonged exposure to elevated doses of biocide formulations. This was mainly attributed to the modifications of receptor binding sites of the larvicidal principles in the insect midgut epithelial cells. Attempts have been made to design strategies to develop better biopesticides which would delay / avoid the development of resistance. This is possible by developing formulations containing heterogeneous mixtures of insecticidal crystal proteins exhibiting similar target specificity. The heterogeneous mixtures were developed by the use of mixed cultures of different strains of *Bacilli*. It has also been attempted to understand the various interactions between the strains and the impact on the expression of insecticidal crystal proteins. In addition, attempts have also been made to exploit the hyper expressing heterologous vector-host system. The insecticidal crystal proteins have been engineered under strong heterologous promoters. The expression levels of these proteins in the heterologous expression system are comparable with that of the wild-type organisms. It has also been attempted using PCR to isolate novel / highly potent strains of *B. thuringiensis* by the use of genetic methodologies. PCR protocols have been extensively used to rapidly screen the strain of interest from the environmental samples. A number of other genetic engineering strategies such as site directed mutagenesis have also been adopted to gain further insight into the binding affinity and specificity of insecticidal crystal proteins and to establish structure function relationships.

Recent Developments in Research on Tissue Stage of Malaria Parasite

Kamboj K.K.

Division of Parasitology, Central Drug Research Institute,
Lucknow 226 001

Malaria sporozoites following their inoculation into the blood stream by infected *Anopheles* mosquito are quickly taken up by the liver cells where they undergo a silent phase of multiplication developing into tissue stages or exoerythrocytic (EE) forms. The EE stages baffled the scientists for many decades and were discovered only in the 1940's. Because of their deeper location, these stages remained inaccessible and as such didn't generate much interest amongst the malariologists. Recent developments indicating the vulnerability of the EE forms to host immune response have generated renewed interest in these stages. Successful cultivation of the tissue stages of *Plasmodium* in primary cultures of host hepatocytes and a wide variety of hepatoma cell lines have greatly facilitated research on these stages.

Exoerythrocytic stages of all the four human plasmodia species have been successfully cultured. However, the difficulty of obtaining human liver biopsy and dependence on infected human blood for sporozoite supply especially in the case of *P. vivax* poses definitive limitations in research on EE stages of human plasmodia species. As such, the use of non-human primate and rodent species of plasmodia as alternate models has been exploited. We have found these *in vitro* systems to have great potential as primary screen models for identifying new tissue schizontocidals and potential candidate immunoprophylactic agents for malaria. The usefulness of plasmodial ribosomal RNA probe for tissue stages will also be discussed.

Relevance of Integrated Pest Management in the Present Agricultural Scenario in India

Veeresh G.K.

Vice-Chancellor, University of Agricultural Sciences, Bangalore 560 065

India has its long agricultural tradition but nowhere we have come across the resurgence of pests which has taken place on wide varieties of crops during 20th Century. The reasons are many; but certainly the technologies and inputs applied in the anxiety of increasing food production to match the growing population led to the disastrous phase, particularly in the latter half of 20th century. High yielding varieties, indiscriminate use of fertilizers and pesticides and growing crops during non-traditional seasons with artificial irrigation are some of the major factors in the increase of pest outbreak.

In the recent years there have been awareness among the Agricultural scientists and farmers that unless we reverse this trend the future of sustainable agriculture would be in peril. Several Agricultural Universities in the country and ICAR Institutions have taken up measures that would keep the pest below the economic threshold. The method is termed as "Integrated Pest Management".

For effective Integrated Pest Management (IPM), one must have a complete knowledge of crop eco-system rather than keeping the pest or disease as the target. 'Prevention is better than cure' is an age old saying but more relevant these days in plant health management. It has been shown all over the world that wherever lethal methods have been used in excess, there have been more number of pest incidences than in places where least of pesticides used. Therefore, the first priority in the IPM is to keep the pesticide as a last resort rather than first preference.

Each crop at a particular Agro eco-system needs a package of its own for reducing the pest incidence. It starts with the Integrated Plant Nutrient Management by reducing nitrogenous fertilisers which has induced pest incidences. Encouraging natural enemies, augmenting parasitoids, using bio-pesticides, using trap crops, using of non-synthetic pesticides and saving the post-harvest losses to compensate the losses due to pests and diseases, if any, are some of the components of IPM. These will be discussed citing some success stories.

Molecular Biology of Vector Mosquitos: Current Status and Future Developments

Dileep N. Deobagkar

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Mosquito-borne diseases continue to be a major problem in both human and veterinary health. Diseases like Malaria and Dengue fever seem to occur with increasing frequencies, and control of spread of these diseases has made it essential to develop new strategy for vector control. Molecular Biology of Mosquito in general and *Anopheles* in particular is known to a very limited extent. From the national interest, under our environment, it is essential to obtain basic information on *An. stephensi* which could be useful in identifying molecular basis of pesticide resistance as well as host interaction with the parasites i.e., susceptibility and refractivity for particular parasite. Several laboratories including our own, have been investigating the possibility of using gene manipulation in the mosquito genome to understand the molecular basis of the competence of this insect as a disease vector. One of the major step in this approach is to develop a suitable vector for introducing foreign genes in the mosquito cells. However, search for endogenous retroposon element of mosquito has still not yielded success anywhere. Such an element could be used to construct specific vector for mosquito. On International scene, such transposons for non-drosophilid insects including mosquito seem to be feasible in near future. *Hobo* like elements are of interest for this purpose. We have isolated and characterised a few of the genomic sequences belonging to MboI repeat family from the *An. stephensi*. Some of these resemble retroposon at the sequence level. Cytological analysis in combination with molecular analysis suggest these sequences to be good candidates which could lead to identification of functional retroposon like element. Chromosomal localisation of these sequences could also be further explored by incorporating these sequences in the vector. Homologous and specific promotor sequence of *Anopheles* heat shock protein gene is also isolated. The combination of such elements is envisaged to lead in developing the desired vector. Identification of important developmental regulatory genes

including homeotic genes is also of interest in mosquito research. We have isolated and identified one such putative homeo domain gene with helix-turn-helix motif. Its interaction with DNA has been proposed using *Drosophila* model. This sequence has been found to be conserved in other insects as well as in mammals. This novel homeotic gene seems to be involved in development/differentiation of peripheral nervous system. Alongwith the molecular biology of the malarial vector, other biological aspects of development of cross tolerance to the environmental stress factors such as temperature or pesticide are also being investigated. These results will be presented in relation to developments in this field at the international level.

Biological Clocks ✓

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The environment we live in is spectacularly periodic. Plants, animals and humans have adapted themselves to the *temporal* order of the environment, as they have to the *spatial* order. The subject of ecology examines the adaptations of the organisms in space and the subject of chronobiology examines the adaptations of organisms in time. Today's lecture will be on chronobiology especially my own work and those of my students at the Department of Animal Behaviour and Physiology, Madurai Kamaraj University, Madurai.

We have studied the activity: rest patterns (which is regulated by endogenous clocks also called circadian clocks) of the members of colony of ca 600 bats (insect catching) living inside a cavernous cave ca 40m deep. There are no signs of day or night in this cave in as much as it is perpetually dark inside, the temperature constant $27^{\circ}\text{C} \pm$ nothing and 96% RH. We discovered through ingenious experiments that "bats tell other bats time" of sunrise and sunset. In other words, we discovered a very impressive social synchronization of the circadian rhythms in this insectivorous bat, which appears to be species specific.

Field mice, like bats, also live in darkness inside burrows and forage only during night time. We investigated how the new-born pups with eyelids closed until day 7 or 8 after birth know time of day. Ingenious experiments, the first of their kind, revealed that the presence:absence cycles of the mother mouse give away information of time of day and night to her pups. The presence of the mother is taken to mean it is day and absence is interpreted as night. This is a first report of maternal behavioural entrainment of circadian clocks in mammals.

Since 1987 we have been working on human circadian rhythms making sleep-wakefulness and rectal temperature measurements on human subjects who were maintained in a specially constructed "isolation facility" for periods of 21-42 calendar days. We have on hand much fascinating novel information. These experiments are being continued by me and my colleagues at MKU and JNCASR at least for another five years or more.

An Analysis of Malaria Mortality Worldwide

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The global spectrum of endemic malaria transmission rates range from around 0.01 to 1,000 infective bites per person per year, with the highest transmission rates (annual entomological inoculation rates (AEIRs) of about 8 per person and beyond) being encountered in sub Saharan Africa. In regions of Asia, where malaria constitutes one of the biggest health problems, the AEIRs span the lower end of the scale, ranging from about 0.01 per person as encountered in Sri Lanka, to about 8 in parts of Myanmar. In this analysis, the *P. falciparum* malaria incidence, and the mortality rates due to malaria have been examined for the entire global range of malaria transmission intensities, using published data in the case of sub-Saharan Africa, and for Asia using information from the national health data bases of the countries. These morbidity and mortality statistics from the countries reflect not only the inoculation rates but also the prevailing health system for malaria case management which appear to play a major part to play in determining morbidity and mortality patterns in the region.

Epidemic malaria, at any AEIR, would, due to a lack of immunity in the populations, give rise to high malarial mortality rates starting from 10 per 10,000 population at an AEIR of 0.01 to 3000 at the highest AEIRs, it being curtailed in the high transmission areas by the occurrence of superinfection, due to saturation being reached. In contrast, where malaria is endemic, acquired immunity in the population begins to reduce malaria mortality by reducing both the incidence of malaria as well as the case fatality rates, the latter occurring particularly at high AEIRs(>10). In endemic situations where populations have little or no access to treatment, at the range of AEIRs prevalent in Asia (0.01 to 8) mortality rates of 12 to 15 per 10,000 population will be encountered. However, the actual malaria mortality rates retrieved from the national health statistics of these countries are about 150-200 fold lower (range 0.1 to 3 per 10,000 population). The case fatality rates of malaria

in these countries in Asia, as derived from actual data are also quite low (ranging from 1 per 10,000 *P. falciparum* infections in Sri Lanka to 3 per 10,000 in Myanmar), compared to case fatality rates that would prevail if these populations had no access to treatment, which are estimated to be 300 to 150 per 10,000 infections respectively, they too being more than 200 fold greater.

Thus, an enormous reduction in case fatality rates of *P. falciparum* and its mortality rates is being achieved in Asia as result of the health system for malaria treatment. It is shown here, that this in large part due to prevention of *P. falciparum* infections progressing to severe and complicated malaria, which, even under the best of tertiary care conditions is associated with a mortality rate of 10-15%. An analysis of treatment practises for malaria in endemic regions of Sri Lanka, in relation to the risk of *P. falciparum* infections progressing to severe and complicated malaria have shown that a very large proportion of potentially severe and complicated malaria infections is prevented by terminating these infections before the risk ensues. As is generally known, these analyses also show that in Asian malaria situations, reducing the AEIR by vector control will result in a proportionate reduction in the malaria incidence and thereby in the mortality rates. However, the reductions in malarial case fatality and mortality rates achieved by early case detection and treatment, as shown above, exceed by far, those achieved by other methods such as vector control. These facts would be important for formulating malaria control strategies in Asia, and may have application even in other situations such as in Sub-Saharan Africa.

✓ Diseases and their Adverse Effect on Productivity and Economic Development

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The health problems caused by various forms of diseases including malaria and other tropical diseases in poverty ridden economics in South Asia have a direct bearing on socio-economic development of these economics including India. Hence several studies have amply revealed in all these economics that an aggregate economic growth is not an end in itself unless it brings about simultaneous improvement in the health-status which is deemed to be a major component of wealth and welfare of people as a whole. Because the status of health is one of the major indicators exemplifying the levels of human development which ensures a strong base for economic growth with stability.

There is thus a wide-spread recognition in the contemporary world on the importance of health as one of the potential factors promoting not only human capital but also the ability (measured in terms of productivity which is a function of sound health) of individuals to contribute their might for development. It is in this sense that we say health which is free from disease is an important asset of ones welfare.

But it is unfortunate that India has been characterised as a country with a low level of human development since its ranking order (of Human Development Index) as calculated by the U N D P is 135 among 174 countries. This is lower than what it is in smaller countries like Sri Lanka, Thailand and Philippines. This dismal performance may be attributed to the fact that a) The percentage of expenditure on medical, public health, sanitation and water supply during the nineties was only a little over 4% of the Union and all the State Governments put together during the nineties. And similar was the trend during the preceding period too. This amounts to low per capita of expenditure which ranges from as low as Rs. 28/- (Uttar Pradesh) to as high as Rs. 93/- (Maharastra) and b) The tragedy of our health policy is that it has bias towards curative rather than preventive measures.

Study of Mosquitogenic Conditions using Remote Sensing and Geographic Information System.

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To obtain the environmental parameters which largely influence the mosquito population through conventional surveys and the methods of collection are time consuming. The remote sensing earth orbiting satellites provide valuable data at periodic intervals.

Mosquito problem in-and-around Delhi is studied using Indian Remote Sensing Satellite (IRS LISS II data which showed maximum density of mosquito in most part of Delhi. A study carried out in Chandrapur Taluk in Maharashtra to demonstrate the role of remote sensing and geographic information system (GIS) IRS LISS II data of different seasons was used to derive various thematic maps on 1,50,000 scale after extensive field data collection and verification. Based on the interaction with the officials of the Malaria Research Centre, New Delhi, favourable conditions of mosquito breeding were listed. The areas with high scores were found to be matching with high incidence of malaria in these villages.

Spatial Resolution of IRS LISS i.e. 36.25 m restricts the identification and area estimation of water bodies of smaller sizes. The data from LISS II/III sensors could be used for the larger water bodies.

CONTRIBUTED PAPERS - ORAL

①

Problems of Filariasis in India and the Pros & Cons of Control Strategy

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Wuchereria bancrofti in India has been showing increasing trend in spite of the National Filariasis Control Programme (NFCCP) being in operation since the last four decades. In 1970 it was estimated that 136 million people were exposed to the risk of infection, while the current estimate showed more than three fold increase within an interval of two-and-a-half decades. The reasons for such an increase have been attributed to extension of delimitation surveys in hitherto unsurveyed districts, natural growth of population in the endemic areas and spread of infection to new areas previously known to be non-filarious. Fortunately, *Brugia malayi* infection has been showing declining trend on account of reclamation of land for real estate development, manual removal of host plants for agriculture practices, collateral benefit of residual spray under NMEP, replacement of hospitable host plants with new flora and increased availability of filaricidal drugs combined with awareness for better personal hygiene.

Presently, NFCCP is confined to less than 11 percent of endemic population in urban areas only. The strategy at the inception of the programme was targeted in both urban and rural areas in the ratio of 2:1. Within five years of launching of the programme, the control measures were totally withdrawn from rural areas due to technical and operational constraints. The main strategy in NFCCP (recurrent larval control) is not operationally feasible in rural areas. There is an urgent need to extend the benefit of national programme to rural areas which constitute nearly three fourths of the problem in the country. Moreover, the present strategy did not show any reduction in microfilaria rate in 26 per cent of towns and disease rate in 31 per cent of the towns despite the programme being in operation for more than a decade in such towns. The present control measures require drastic changes so that a revised control strategy could be effectively implemented in both rural

and urban areas in cost-effective manner suitable to developing countries. Single day DEC mass therapy at a dose of 6mg/kg body weight once a year appears to be the best alternative in the light of highly successful results obtained in some endemic countries like Taiwan, South Korea, Japan, Solomon Islands and China.

2

Changing Concept in Kala-Azar Therapy

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At the Calcutta School of Tropical Medicine, Amphotericin B is now usually used as a third line antileishmanial drug. In our study, 30 cases of Kala-azar were treated with Amphotericin B in daily dose of 0.8mg/kg body weight and cumulative dose of 20mg/kg body weight both in fresh cases and SAG failure, even Pentamidine failure cases. The results are encouraging and this has prompted us to believe that Amphotericin B can be the drug of first choice in cases of Kala-azar except for its cost. We compared toxic effects of Pentamidine and Amphotericin B which places Amphotericin B in a more favourable position than other antileishmanial drugs.

3

Population Fluctuation of *Phlebotomus argentipes* in District South 24-Parganas, West Bengal

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A study to observe the population fluctuation of *Phlebotomus argentipes* (the vector of Kala-azar in India) in a highly Kala-azar endemic area of West Bengal was conducted during 1992-94. The species was abundant throughout the year with a minimum and maximum Per Man Hour Density (PMHD) in January (7.5) and September (41) respectively. Statistical analysis shows a

positive correlation between PMHD of the files and the temperature & humidity of the collection site. The study indicates that risk of transmission of the disease is probably maximum during the later part of monsoons (i.e. during August-September). The observations are significant and important since they indicate the period of the year when insecticide spraying would be most effective.

4 ✓

Malaria Situation in Karnataka

Murugendrappa M.V.

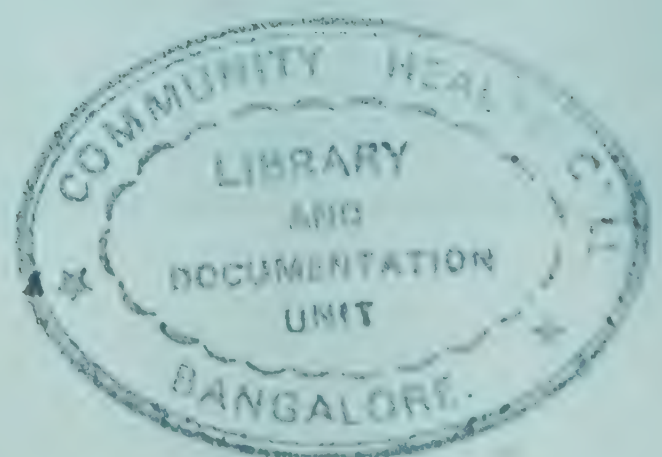
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The malaria activities in the State is being implemented as per the guidelines of Directorate of NMEP-Govt. of India.

Malaria has been increasing not only in Karnataka but also throughout the nation since 1993. Half of the Global population is exposed to the risk of malaria. It is basically a local and focal problem.

The disease which was mainly a problem in rural areas, has now extended its tentacles to Urban Agglomerations and posing a challenge to malaria experts in its control.

In Karnataka, Bellary and Mangalore cities are reporting high incidence of malaria while the Districts of Mandya, Bijapur, Kolar, Hassan, Tumkur, Chitradurga and Chickmagalur are having considerable malaria problem. Collective efforts has brought down the incidence during 1996 by 30% as compared to the previous year. Special measures have been adopted for control of malaria in the State, which are giving very good results and it is expected to bring down the incidence during 1997 to less than One Lakh and the mortality rate due to malaria to 'Zero' level.



Epidemiological and Environmental Determinants of Malaria in the Third World Countries: A Study with Special Reference to India

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Malaria in man is caused by four distinct species of malaria parasites - *P. vivax*, *P. falciparum*, *P. malariae* and *P. ovale*. *Plasmodium vivax* is the dominant one which has shown the widest geographic distribution throughout the world. In India, about 70% of the infections are reported to be due to *P. vivax*; 25-30% due to *P. falciparum* and 4-8% due to mixed infection. India is reported to have an annual increase of 75 million cases with an infant parasite rate of 3.9 and an infant parasite rate of 1.6. The economic loss due to the man days lost at one-time was estimated to be nearly Rs. 10,000 million per year. Malaria affects all ages. Males are more frequently exposed to the risk of acquiring malaria than females. Malaria is more prevalent in under developed countries than in developed countries. Where economic conditions are good the incidence of malaria is low, if not absent. It was found that economic depressions and housing played important roles in the epidemiology of malaria. The other host factors that may determine the outbreak of malaria are migration at various scales, human habits and immunity and so on. The environmental factors such as geographic position and climatic conditions are favourable to the transmission of malaria. Season, temperature, humidity, rainfall and altitude are the various environmental factors that determine the outbreak of malaria in an extensive manner. The present study is an attempt to analyse the spatial distribution of malaria in developing countries with special reference to Tamilnadu (India) and to bring out the variation in the epidemiological and environmental variables. The study also attempted to identify the major epidemiological and environmental determinants. The study was based on the secondary data available at all levels and also from case studies and published reports.

It was noticed that in the next century that climate change is expected to increase the global incidence of malaria by 50-90 million additional cases each year. The proportion of the world population exposed to the potential transmission of malaria is expected to increase from the current 45% to around 60%.

6

Bio-Environmental Control of Malaria -- The Karnataka Experience

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Bio-environmental strategy is an alternate method of control for malaria and other vector borne diseases in the recent years. This method is under implementation in three Primary Health Centres (PHCs) in Karnataka covering about two lakh population. PHC Kamasamudram in District Kolar was taken initially in 1994 as a demonstration site as malaria was increasing with high refusal rate for DDT spray by the local people for possible damage to the silk industry. Subsequently, in 1996 PHCs Banavara and Kanakette in District Hassan were taken where malaria was causing a serious problem. Extensive Geographical Reconnaissance (GR) was carried out in these areas. It is revealed from GR that two vector mosquitoes *Anopheles culicifacies* and *An. fluviatilis* are present and mainly breed in wells and streams. Preliminary study on sibling species showed that *An. culicifacies* A mostly breeds in wells while species B in streams. Likewise, *An. fluviatilis* found to be species T which is refractory to malarial infections. Larvivoracious fish - *Lebistes reticulatus* (Guppy) and *Gambusia affinis* were released in the breeding sites. In all the areas an overall reduction of 60% to 70% malaria cases is recorded when parasitological data are compared in the corresponding

years. Whereas malaria is on the rising side in the neighbouring PHCs. A separate set of trial on synthetic pyrethroid (Cyfluthrin) impregnated bed nets is undergoing in PHC Kanakatte covering a population of 8100. Parasitological data revealed no difference between bed net and bio-environmental control; whereas bio-environmental control showed better results when data on larval densities are compared. This shows bio-environmental method offers better way of malaria control in Karnataka.

7

Genetic Studies among Gond Tribals of District Mandla, M.P.

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Blood samples collected from Gond tribal population living in District Mandla, Madhya Pradesh were analyzed for ABO and Rh blood groups, Duffy antigen, haptoglobin polymorphism, haemoglobinopathies and G-6-PD deficiency as well as electrophoretic variations. Data were analyzed in respect of malaria positive and malaria negative subjects. Study shows a significantly higher incidence of functional ahaptoglobinemia (HpO) among malaria positive subjects compared to malaria negative subjects. Also a higher incidence of sickle cell haemoglobin and G-6-PD deficient gene were observed in the population.

8

Development of Artemisinin based Antimalarial Drug Arteether and Related Compounds

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Malaria continues to be one of the most serious public health problem in almost all the developing countries. The disease is endemic in more than 102 countries placing over half the world population at risk. At present, there is a rapid increase of resistance of the malarial parasite to currently used antimalarial drugs. Artemisinin, endoperoxide sesquiterpene lactone iso-

lated from *Artemisia annua* - a Chinese plant is a highly potent antimalarial drug. During the past decade, it has opened broad prospectives for development of new antimalarials. Artemisinin as well as its semi-synthetic derivatives such as dihydroartemisinin, artemether, arteether, artesunate and artelinate are promising drug candidates for antimalarials.

In India the drug for cure of malaria is being developed as arteether (30:70 mixture of α : β isomers). This drug has completed III phase of clinical trials and was found extremely useful in curing multidrug resistant and cerebral malaria. We have developed appropriate agrotechnology for the cultivation of *A. annua* plant under temperate and semi-tropical climates of the country, processing technology for the isolation of artemisinin and semi-synthesis of drug arteether. All the technologies are suitable for the commercial production of drug arteether.

9

Antimalarial Spectrum of Azithromycin in Experimental Malaria Models

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The search for new antimalarial drugs is of great concern in the light of current worldwide resurgence of drug resistant malaria. Apart from efforts aimed to develop new drugs directed against novel parasite targets, the strategy to use antibiotics to potentiate the effect of available antimalarial drugs has been useful in preventing the spread of drug resistant strains. The antimalarial spectrum of azithromycin, new macrolide antibiotic with longer half life and better bioavailability was evaluated against a chloroquine resistant rodent malaria parasite *Plasmodium yoelii nigeriensis*, and the activity compared with macrolide agent erythromycin. Azithromycin, administered to *P.yoelii* infected mice at 70 mg/kg (x 4 days) exhibited curative blood schizontocidal activity and a dose dependent suppression of parasitaemia was observed at lower doses. Compared to erythromycin, azithromycin was 7.7 times and 30 times more effective at ED₅₀ and ED₉₀ level. Azithromycin also exhibited causal prophylactic activity and mice treated at 50mg/kg dose for 3 days were protected against *P.yoelii* sporozoite challenge.

The antimalarial profile of azithromycin was also evaluated against both blood and sporozoite induced infections of a simian parasite *P. cynomolgi*. In the causal prophylactic test the development of patent infection was significantly delayed in rhesus monkeys treated at 25 mg/kg x 9 days suggesting partial efficacy against growing pre-erthrocytic schizonts. In the radical curative test, 25 mg/kg dose x 7 days did not prevent the subsequent relapses, indicating lack of hypnozoitocidal efficacy. Against trophozoite induced infections, dose of 25 mg/kg x 7 days cleared the blood stage infection and treated monkeys did not show any recrudescence during subsequent 60 days. The study projects azithromycin as a possible candidate agent which can be useful both for prophylaxis and therapeutic application either alone or in combination with antimalarial drugs.

10

Antimalarial Action of Cyproheptadine Against Drug Resistant Malaria

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A multidrug resistant strain *Plasmodium yoelii nigeriensis* which exhibits high level of resistance of chloroquine, melfoquine and quinine, was used for the antimalarial evaluation of several antihistaminic compounds out of which cyproheptadine was found to exert direct antimalarial action against the blood stages of the parasite. The comparison of the cyproheptadine (20mg/kg x 7 days) with quinine (400mg/kg x 7 days) showed that cyproheptadine exerted a better antimalarial action against the parasite than quinine. The group of mouse treated with quinine showed mean survival time of 15.25 days where as the group treated with cyproheptadine showed extension of mean survival time to 21.2 days. This study provides new lead for evaluation of antihistaminic / 5-HT antagonist for potential antimalarial action against resistant malaria. In our study against MDR, *P. yoelii nigeriensis*, cyproheptadine showed better suppression of parasitaemia as compared to the conventional antimalarials viz. quinine,

mefloquine and chloroquine. The radical curative, causal prophylactic and gametocytocidal potential of cyproheptadine still remain to be explored.

11

Efrapeptin: A Fungal Metabolite with Potent Antimalarial Properties

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Malaria caused by the protozoan parasite *Plasmodium falciparum* is a major health hazard in the developing countries. The asexual stage of the parasite is intraerythrocytic and the parasite differentiates into the three different stages, rings, trophozoites and schizonts. Efrapeptin, a peptide, containing 16 amino acids is a metabolite of the fungus *Tolypocladium inflatum*. It contains four unusual amino acids, namely, α -aminoisobutyric acid, pipecolic acid, β -alanine and isovaline. The N-terminal of the peptide is acetylated and C-terminal is amidated with a novel heterocyclic amine, N-peptido-1-isobutyl-2-[1-pyrrolo-(1,2)pyrimidium-2,3,4,6,7,8-hexahydro] ethylamine. It is an alkylation product of 1,5-diaza-bicyclononene (DBN) with L-leucinol. Efrapeptin is known to inhibit the mitochondrial F_0F_1 ATPase. The aim of the study is to evaluate the effect of efrapeptin on *P. falciparum* growth in *in vitro* cultures. The effect of efrapeptin on *P. falciparum* over various time periods and on various stages of the parasites was examined IC_{50} for *P. falciparum* killing, stage and time dependence will be presented. Effect of the C-terminal modification, DBN on parasite growth will also be presented and compared with that of efrapeptin. A probable mode of action of efrapeptin on *P. falciparum* will be hypothesized.

Ayurvedic Treatment for Malaria

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In our ancient classics, like Vagbhat, Susrut and Charak has dealt in detail about malarial fever i.e. Vishama Jwar (विषमज्वर). In ancient times, they have concluded that it is epidemic i.e. Contagious one and also, it is attacked by external bite of mosquitos i.e. Jeevanu.

केभिद्भूताभिषङ्गोत्थं ब्रूवते विषमज्वरम् ।

They gave clear picture of Vishama Jwar like this :

विषमो विषमारम्भक्रियाकालोनुषङ्गवान् । वाग्भट

Spreading of this disease has no specific time, no early symptoms and vitiation of the dosha's. So it is called as Vishama Jwar. They have classified in five categories :

1. Remittent or Continuous fever (संतत ज्वर)
2. Double quotidian fever (सतत ज्वर)
3. Quotidian fever (अन्ययुष्क ज्वर)
4. Tertian fever (तृतीयक ज्वर)
5. Quartan fever (चतुर्थिक ज्वर)

Concerned to treatment, in classics they told Decoction of the herbs, minerals and bhasmas. Here I used herbal Decoction i.e. Mahasudarshan Churna. It chiefly contains Swetaria Chirayat (भूनिम्ब) and other number of herbs. I have treated patients with this medicine and got good results.

In some patients, those who have not responded by modern medicines, that types of patients treated with this medicine along with minerals like Yellow Arsenic (Harital). So in my 13 years of experience, I got good results with this medicine and no relapses. So, this is the best medicine for malaria.

13

Vector Mosquitoes In Development & Spread of *P. falciparum* Resistance to Chloroquine

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Study spread over 15 Districts of Karnataka State highlights the importance of vector studies in relation to drug resistance. Standard Extended Field studies were carried out in 39 Primary Health Centres (PHC) distributed in 14 Districts of the state to find out chloroquine sensitivity status of *P. falciparum*. Entomological collections were carried out in 115 villages of 58 PHCs distributed in 14 Districts of the State. Both entomological collections and drug sensitivity studies were performed in PHCs of 8 Districts of Karnataka. Results of the study revealed prevalence of more than one species of vector mosquito involved in malaria transmission in localities wherever higher *in vivo* chloroquine resistance of *P. falciparum* were noted. Current study has shown the dynamics of development of drug resistance among *P. falciparum* cases by adding scientific evidence to the hypothesis of Verderger. It also explains the spread of drug resistance to many geographical areas where different species of vector mosquitoes are involved. Selection pressure of drug, as a result of intense malaria transmission, appears to be the reason for development and spread of drug resistance.

14

Mosquito Genome - An Heterochromatin Approach

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Among mosquitoes, Anophelines show heteromorphic X-Y pair while most Culicines (for eg., *Aedes*, *Culex* and *Mansonia*) sex chromosomes are not readily distinguishable. General impression is that during meiosis due to

the condensed chromatin configurations of X-Y pair, there is some kind of inhibition of chiasma formation but not in homomorphic pair, and thus to imply there exists some chromosome compositional heterogeneity. Moreover, most Anophelines (like *Drosophila*), in a typical diploid cell, 30-35% of the karyotype is heterochromatic and consequently consists of highly repetitive DNA sequences. An attempt was made to throw some light on some aspects of basic chromosomal architecture to delineate whether compositional difference exists between male and female cells and of Anopheline and Culicine genomes.

Applications of classical C-staining studies on the genome have revealed that extensive constitutive heterochromatin was found over the paracentromeric regions of autosomes and most of sex chromosomes in Anophelines, whereas in Culicines staining profiles are confined to centromeric regions. An attempt was made to procure data on chromosome morphology in response to *in vivo* effect on some DNA-specific ligands (BrdU, Hoechst 33258, Ethidium Bromide, Acridine Orange and 5-Azacytidine) on the embryonic and adult chromosomes of *Anopheles* (*An. stephensi* and *An. nigerrimus*), *Culex* and *Aedes* and of subsequent staining by appropriate protocols. This report demonstrates that the pretreatment of live cells to various DNA-ligands have altered the basic architecture of chromosomes, in particular to heterochromatin compaction.

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Polytene Chromosome Characteristics of High Altitude Sympatric Species of Mosquitoes (Diptera : Culicidae)

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The concept of species complexes in mosquitoes has provided sufficient impetus for detailed investigations on the comparative cytogenetics of the species and species populations in the genus *Anopheles*. Added to this are the activities of man in modifying the genetic structure of these insects. The present paper deals with the results of polytene chromosome studies on

Anopheles lindesayi and *Anopheles splendidus*. Both are adapted to high altitude conditions as compared to conventional habitats of mosquitoes. The normal banding pattern of the salivary polytene chromosomes and inversion polymorphisms was recorded in the two sympatric populations of these species. The frequency of inversions was higher in *lindesayi* which also differed from *splendidus* in having two fixed paracentric heterozygous inversions in chromosomes X and 3 respectively. The entire data has been discussed in relation to their ecological preferences and adaptive significance of the inversions.

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Role of *An. fluviatilis* Sibling Species in Malaria Transmission in the Districts of Orissa State

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Taxon *An. fluviatilis* has been identified as a complex of three sibling species which are provisionally designated as species S, T and U and can be identified by fixed paracentric inversions on the polytene chromosomes. Surveys were carried out in Districts Koraput and Malkangiri (Orissa) to study *An. fluviatilis* sibling species composition, their feeding and resting behaviour and role in malaria transmission. Species T population from District Koraput was found polymorphic for q1 inversion and was exclusively zoophagic whereas species S prevalent in certain villages of District Koraput and in all the villages of Malkangiri were almost anthropophagic. Furthermore, the cytologically identified species S was incriminated from District Malkangiri suggesting it to be very efficient vector.

Genetics of Speciation in the *Aedes (stegomyia) scutellaris* Group (Diptera: Culicidae)

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Aedes scutellaris group is comprised of over 30 closely related species widely distributed in the Southeast Asia, and the South Pacific islands. Many species of this group are proven vectors of filaria and dengue virus. A multifaceted approach including experimental hybridization, cytological analysis and formal genetics was undertaken to understand the mechanism of speciation in this species group. Interspecific crosses among 7 species revealed that *Ae. malayensis* x *Ae. alcadidi*, *Ae. malayensis* x *Ae. hebrideus*, *Ae. malayensis* x *Ae. s. katherinensis*, *Ae. hebrideus* x *Ae. alcasidi* and *Ae. hebrideus* x *Ae. s. katherinensis*, were unidirectionally incompatible, whereas *Ae. s. katherinensis* x *Ae. alcasidi* were bidirectionally compatible. In addition, *Ae. polynesiensis*, *Ae. pseudoscutellaris* and *Ae. kesseli* were mutually bidirectionally compatible among themselves. All species had 3 distinct pairs of metacentric chromosomes ($2n=6$). They formed homomorphic pairs in the hybrids of *Ae. malayensis* x *Ae. alcasidi* and those of *Ae. polynesiensis* x *Ae. pseudoscutellaris*. However, chromosome pair 1 in the hybrids of *Ae. polynesiensis* x *Ae. kesseli* and pair 2 in those of *Ae. pseudoscutellaris* x *Ae. kesseli* were heteromorphic. Meiotic analyses revealed that there was considerable chromosome asynapsis in species hybrids, and the mean chiasma frequency was species specific. Based on the anaphase-1 cytology, it was evident that *Ae. malayensis* and *Ae. alcasidi* are polymorphic for one paracentric inversion in chromosome 1, while *Ae. polynesiensis* x *Ae. pseudoscutellaris* & *Ae. pseudoscutellaris* x *Ae. kesseli* were fixed for one paracentric inversion in chromosome 2. Similarly, *Ae. polynesiensis* x *Ae. kesseli* were fixed for one paracentric inversion in chromosome 1. Furthermore, genetic analysis of morphological differences among *Ae. polynesiensis*, *Ae. pseudoscutellaris* and *Ae. kesseli* indicated

major gene substitutions with some modifiers. The data thus obtained indicated that hybridization has been a potent factor in speciation together with geographical isolation and cytoplasmic differentiation.

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Genetics of Grey Larva: Mutant in *Culex pipiens quinquefasciatus* - the Filarial Mosquito

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Vector genetics is an important aspect of genetic control strategies used to control transmission of diseases. Mutants with the viability as good as that of wild type are excellent genetic markers and can be used for the design of strains for genetic control.

This paper describes the genetic studies of naturally occurring mutant Grey green (gg) larvae in *Culex pipiens quinquefasciatus*. The grey green colour appears in the early third instar larvae and darkens during the fourth instar. The maintenance of the mutant is as easy as that of the wild type. The mutant gene gg is an excellent marker for *Cu. p. quinquefasciatus*. The mode of inheritance of the mutant will be presented.

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Genetic Study of Resistance to Fenthion in *Anopheles stephensi* Liston

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Anopheles stephensi is an important malaria vector in Indian sub-continent. Although genetic basis of OP-insecticide resistance has been studied in a few-species of mosquitoes, the information on genetics of fenthion resistance in anopheline mosquitoes is scanty. In a study to establish the genetic basis of fenthion resistance in *An. stephensi* for a Bangalore strain (WG), a diagnostic dosage of 0.05 ppm fenthion was used for the third instar larvae during a 24 hour exposure in the laboratory. Various genetic crosses were used, including presumptive homozygous, resistant, susceptible, F_1 hybrids, back-

crosses and F_2 generation. The resistant-susceptibility and dosage-mortality relationships clearly show that fenthion resistance was incompletely dominant in *An. stephensi*.

Esterase Isozymes of Organophosphate Resistant Strains in *Anopheles stephensi* Liston

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Though mosquitoes have developed resistance for various type of insecticides, the organophosphate (OP) chemicals are still being used for control of malaria vectors, including *Anopheles stephensi*. The studies are scanty on esterase isozymes associated with insecticide resistance in *An. stephensi*. Hence, the present investigation deals with changes in protein and esterase isozyme patterns during developmental stages of a few OP-insecticide (fenthion, methyl parathion and malathion) resistant and susceptible strains of *An. stephensi*, by using polyacrylamide gel electrophoresis. The zymogram and number and intensity of proteins and esterase bands in the resistant strains, as compared to the susceptible strains.

Genetic and Biochemical Basis of Insecticide Resistance to Deltamethrin - A Synthetic Pyrethroid in *Culex quinquefasciatus*

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Resistance to insecticide poses a serious threat to the conventional control measures for vectors, especially in mosquitoes. The knowledge of the genetic and biochemical basis of resistance is very essential for the effective management of resistance in vectors. In the present study, resistance to the synthetic pyrethroid Deltamethrin in *Culex quinquefasciatus* has been carried out.

Seven strains of *Culex quinquefasciatus* from Peninsular India, out of which five from filaria prone regions were tested for their baseline susceptibility to the insecticide Deltamethrin. For determining the diagnostic dosage the LC_{50} values were computed and the concentration of 0.004 ppm was arrived at. The Mangalore strain which had the LC_{50} value of 0.000207 ppm was selected and a 100% resistant stock for the diagnostic concentration of 0.004 ppm was raised in the laboratory. Crosses were carried out with the susceptible stock for the diagnostic concentration to determine the genetic basis of inheritance.

The biochemical studies on the general protein and esterase levels in the different stages, such as eggs, larvae, pupae and adults involving the quantitative assay and electrophoretic patterns were carried out.

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Genetic Study of Deltamethrin Resistance in *Anopheles stephensi* Liston - A Malaria Mosquito

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An. stephensi is one of the important vectors of malaria in Indian sub continent. It is a member of the subgenus *Cellia* and series *Neo-cellia*. Mosquitoes have developed resistance to various types of insecticides including organochlorides and organophosphates. Deltamethrin has been extensively used in India because of its bio degradability and low mammalian toxicity to control *Anopheles* vectors, including *An. stephensi*.

A diagnostic dosage of 0.004 ppm of Deltamethrin was used to separate the laboratory produced homozygous resistant, F_1 hybrids and susceptible strains. The progeny of these back-crosses and F_2 generations were also treated with the above dosage. The data on resistance-susceptibility and time-mortality relationship shows that Deltamethrin resistance was incompletely dominant and autosomal. There is a remarkable variation in respect of the sex ratio, fecundity and egg hatchability between the resistant and susceptibility strains.

Total as well as soluble protein content and general esterase activity in resistant strains of Deltamethrin has been found increased.

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Efficacy of Neem Oil as a Repellent Against Urban Malaria Vector, *Anopheles stephensi* Liston 1901 in Chennai

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A field study was conducted to evaluate the repellent action of neem (*Azadiachta indica*) against urban malaria vector *Anopheles stephensi* in Anna Nagar, Chennai. Two different concentrations of neem oil mixed in coconut oil (2 and 5%) were applied to the exposed body parts of human volunteers. A total of 23 collections were undertaken between August '95 and January '96 consisting of 11 indoor and 12 outdoor night collections. Results indicated 92.5 - 93.3% protection during 12 hour period of observation from the bites of *Anopheles stephensi* against untreated control. The study reveals that neem oil, an indigenous product would be an ideal solution to protect against *Anopheles stephensi* bites in an urban area.

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Cannibalism in Mosquito Larvae: A Novel Approach of its Biological Control

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A new strain of *Anopheles stephensi* has been found. The larvae of this new strain feeds directly on normal larvae. They detach the head and posterior extremity and feed on the middle part. This cannibalistic activity can be used for its biological control; an entirely new approach of malaria control.

Malaria Control through a Simple Technique

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The recent advent of more resilient and drug resistant strains of malaria has led to the disease reaching epidemic proportions in various parts of the Indian subcontinent. The pressure and burden on the resurgence of malaria causes to the struggling economies in developing countries, makes control of this infection imperative and immediate.

In a simple pilot study taken up in a high-risk malaria endemic zone, we experimented with common salt and salinity concentration permutation, as a possible 'source reduction' of the vector, *Anopheles*. The effective larvicidal ratio of salination required to achieve 100% mortality in larval population, in laboratory condition, forms the basis of this project.

Breeding *Anopheles* larva, and then subjecting them to varying concentrations of common salt solution (NaCl); to collect and collate data on viability and mortality rates and demonstrate that salinity alteration is a cost effective, simple and readily available strategy for vector control. Our data outlines the methodology of study and evaluation of results of this simple, yet quite effective malaria control method.

It is our view that common salt could be used as a cheap and fairly reliable larvicide in third world countries. The concentration of salinity required to attain cent percent larvicidal effect can be easily calculated for field application of common salt into breeding larval populations.

Developmental Expression of Single Stranded DNA-Binding Proteins in Malaria Vector, *Anopheles stephensi* (Culicidae: Diptera)

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The expression of single-stranded DNA-binding proteins (ss-DBPs) has been studied by DNA-cellulose column chromatography, SDS-PAGE and densitometric gel scanning during the development of *Anopheles stephensi*. The proteins retained in the DNA-cellulose column were eluted with the increasing concentration of sodium chloride. In total 55 ss-DBPs were identified during all the stages of development. Four DBPs, 115, 117, 150 and 172 KDa, were found to be common in all the stages except eggs in which only three DBPs (16, 61 and 99 KDa) could be resolved. Twelve DBPs (10.5, 14, 16, 20, 26.5, 29, 38, 45, 105, 120, 122 and 172 KDa) were present exclusively in the larva. The other eight DBPs - 21, 24.5, 42, 53, 95, 125, 127 and 175 KDa were pupal specific. The expression of 47 and 137 KDa DBPs was seen only in female adults. Similarly, 75, 90 and 192 KDa DBPs were male specific. The three DBPs - 105, 115 and 195 KDa could bind to native and as well as to denatured DNA. However, 80, 87 and 94 KDa DBPs were exclusively double stranded DNA-binding proteins. The changes in the major DBPs during development and their probable role will be discussed in relation to the characteristics analysed.

Triosephosphate Isomerase of *Plasmodium falciparum*

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The main source of energy for the intraerythrocytic *P. falciparum* is from glycolysis as the tricarboxylic cycle is absent in the parasite. The parasite has

only a single mitochondrion, which has been proposed to play a role in pyrimidine biosynthesis. This makes the enzymes of the glycolytic pathway essential for parasite survival.

We have cloned the *P. falciparum* triosephosphate isomerase (TPI) gene and hyperexpressed in *E. coli*. The purified recombinant protein is active in its dimeric state. The aim of the study is to evaluate the possibility of disrupting dimer formation using synthetic peptides, thereby inactivating the enzyme and consequently, inhibiting the growth of the parasite. Data on cloning of the TPI gene, protein folding and nature of dimerization will be presented.

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Comparative Susceptibility of Different South Indian Strains of *Anopheles stephensi* to Rodent Malaria Parasite *Plasmodium yoelii nigeriensis*

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Anopheles stephensi Liston is one of the important carriers of urban malaria in Indian subcontinent. Malaria has become a major public health problem during the recent years. We have been working on the genetics of *An. stephensi* in our laboratory since two decades. The present paper deals with the study on comparative susceptibility of different strains of *An. stephensi* to *Plasmodium yoelii nigeriensis*.

Five strains of *An. stephensi* were collected from different geographical areas of South India. One each from Pondicherry and Chennai and the rest three from different places of Bangalore. In each batch, starved female mosquitoes were allowed to feed on *Plasmodium yoelii nigeriensis* infected balb-c mice. The gametocytaemia varied from 0.5 to 1.2%. It was observed that Pondicherry (VCRC) strain of *An. stephensi* showed highest percentage of infectivity (87.23%) followed by Chennai (80%), Kengeri (72%), Cubbonpet (71.42%) and Yelahanka (32.51%). It was also observed that the total number

of oocysts was highest in Pondicherry (median 41; range 0-126) and in Chennai (median 39; range 0-116). Among the local strains, Kengeri showed highest amount of oocysts (median 22; range 0-97) followed by Cubbonpet (median 17; range 0-87) and Yelahanka (median 11; range 0-56).

Comparative Susceptibility of Different Strains of *Anopheles stephensi* Liston to *Plasmodium gallinaceum* - Avian Malarial Parasite.

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Susceptibility studies for bird malaria, *Plasmodium gallinaceum* in five strains of *Anopheles stephensi* derived from different geographic areas of India have been carried out. These strains were fed on chicken *Gallus gallus* on 3rd, 4th or 5th days of parasitemia. *Aedes aegypti* was used as control. After dissection of guts of mosquitoes under study, percentage infection and number of oocysts in each of the strain was recorded. From the data, it is clear that there is a considerable variation of infection and number of oocysts, which indicates the status of susceptibility. Accordingly, the Bangalore and Delhi strains of mosquitoes showed a higher percent of infection and the Mulbagal strain showed highest mean and range of infection, i.e., they were more susceptible compared to other strains. The study revealed that the mosquitoes show variation to infection of malaria parasites.

Histological Studies on the Male Accessory Reproductive Glands (ARG) of *Anopheles stephensi* (Liston)

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Accessory Reproductive Glands (ARG) of male *An. stephensi* help in maturation, nutrition and transfer of sperms into female reproductive system. In

addition, ARG has a role in fabrication of mating plugs and spermatophores. Eventhough most of the research work has been carried out on the reproductive physiology of female insects, information regarding male ARG in mosquitoes are scanty. Hence an attempt has been made to investigate the histomorphology of male ARG of *An. stephensi*.

Histological studies on ARG of *An. stephensi* show structural differences at anterior and posterior regions. Six different globules with different shape and size were recognised by staining reaction. The histological variations found in the above gland could be due to the presence of different types of secretory materials. It is presumed that physiological control of ARG may help in control of the species.

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Eco-Epidemiological Characterization of Malaria in Orissa for its Control

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Orissa, one of the 25 constituent States of the Indian Union has been known to be highly malarious on account of its high morbidity and mortality. It lies in the Tropical zone with favourable geo-ecological conditions which are conducive for perennial malaria transmission. The state covers 4.7% of the geographical area with 3.7% inhabitants of the country. Of the two million malaria cases every year in the country, about 15-20% malaria cases and over 30% *falciparum* malaria are contributed from Orissa. Thus, for the state, malaria has been a major public health problem which poses a formidable challenge for its control and prevention.

Broad and generalized classification of malaria based on malaria regionalization of Orissa into Coastal plains, Central Tract, Northern Plateau and Eastern Ghats does not give mutually exclusive classification to get the relationship of geo-ecological factors and malaria occurrence. In Orissa, there exists varied geo-ecological conditions, ethnic composition of population and wide socio-economic variations which play a very important role in the occurrence, distribution and behavioral pattern of the vectors of malaria

and transmission of the disease. The varied terrain conditions associated with different types of forests, crop lands, hills, plateaus, plains, riverine tracts, concentration of tribal population and varied climatic conditions provide different epidemiological niches of varied malaria endemicity. This complexity of the problem needs special attention as there can not be any uniform solution to the varied problems of malaria in different areas. Suitable tools need to be developed by understanding the micro-epidemiological types and their geographical characterization expressed by the determinants of ecological, social and economic aspects which would form appropriate control or preventive strategies or eventual eradication at the micro level. The study attempts to bring out the trends of malaria, their regional variations, epidemiological characteristics and their geo-ecological correlates based on the surveillance parameters of malaria prevalence and incidence at the micro level which may be helpful in guiding the malaria control policy of the State in action planning and strategic intervention.

The study focuses on the fact that there is a necessity for an alternate strategy for delimitation of micro epidemiological types at the micro level and their geographical characterization for adopting suitable and sustainable strategies based on limited resources under the existing primary health care system.

Mechanism of DDT and Pyrethroid Resistance in *Anopheles stephensi* (Diptera - Culicidae) from Bandar - Abbas

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Always, it needs to have proper substitutes for the insecticides which are in use. In this respect, attentions are paid to pyrethroids, but their same mode of action and other properties with DDT and the probability of cross - resistance between them have made the problem more complex then the DDT and pyrethroid resistance inter-relationship must be studied.

For this study the WHO standard adult mosquito susceptibility test kit with some modification was used for carrying out comparative tests between BAN-S (DDT resistant and permethrin susceptible) and BAN-PR (a sub colony of BAN-S that was under permethrin selection for 13 successive generations) and the KT50 were 39.321 ± 2.02 and 85.02 ± 2.01 min, respectively with a resistance ratio of 2.16 ± 0.06 with 0.08% permethrin impregnated filter papers. Piperonyl botoxide 20% synergist test was carried out on adults of BAN-PR and the KT50 decreased to 48.29 min. indicating that P.B has an important role in reducing permethrin resistance in *An. stephensi*. This finding proves the presence of MFO as the permethrin resistance mechanism, but the difference between susceptibility and synergist test using DDT 4% and DDT+DMC 1% on BAN-S were not significant, thus DDT resistance mechanism is kdr like rather than enzymatic.

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Babesiosis: Zoonotic Potential and Immunoprophylaxis in Animals

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Babesiosis is one of the emerging diseases of human beings globally. Splenectomised as well as man with functional spleen are reported to suffer from babesiosis caused by intraerythrocytic protozoan - *Babesia* spp. in various countries like Spain, GDR, Mozambique, Mexico, Belgium, China, Nigeria, U.K., Yugoslavia and USA. Several species of *Babesia* viz. *B. bovis*, *B. bigemina*, *B. divergens*, *B. canis*, *B. equi*, *B. microti* and *b. rodhaini* are reported to infect human beings. The patients suffering from Lyme disease are reported to show the presence of *B. microti* antibodies serologically. The clinical symptoms in human include, fever, chill, sweating, arthralgia, myalgia, nausea, weight loss, prostration and even death.

In order to control the disease in bovines, efforts have been made to cultivate *B. bigemina* under laboratory conditions, following micro aerophilous stationary phase (MASP) culture technique. MASP culture derived cell free lyo-

philized vaccine has been tested under laboratory and field conditions successfully. The results were discussed. The animals vaccinated under village conditions in Orissa are protected over 30 months while animals in the same village which were not vaccinated suffered clinically and required treatment. However, there is a need to conduct a survey in human population for this disease and develop awareness in general about zoonotic potential of the infection.

Protein Profile Study of Particulate Antigen of *Anaplasma marginale*

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Anaplasma is an infectious arthropod borne disease of cattle prevalent in India. It is rickettsial infection in India, is transmitted through the tick - *Hyalomma anatolicum anatolicum*. Particulate antigen was prepared by infecting immuno-suppressed bovine calf using whole blood from a parasitaemic animal. Immunosuppression was achieved through injection of Dexamethasone. Blood from experimental calf was collected and lysed through sonication. Stroma and bodies of *A. marginale* were centrifuged and sonicated again. Protein contents of the washed antigen were determined and appropriate dilution was used to contain 2 mg protein/ml. Antigen was directly mixed with sample buffer containing SDS (1.0 M Tris-HCl pH 6.8) and heated to 100°C for five minutes to break the protein chains and sub-units. Stacking gel of 5% polyacrylamide and running gel of 11% polyacrylamide were used in SDS-PAGE. Gel was subjected to 20 mA current for 2 hrs in stacking gel and 4 hrs in running gel. Rf values with respect to molecular markers proteins were determined as usual.

Analysis revealed that the antigen contained protein in the range of 76-88, 108, 136 and 159 kD. Molecular weight range of 76-88 kD polypeptides showed a consistent and prominent band in each sample analysed.

Prevalence of Trematode Cercariae Infection in the Snail *Lymnaea (Radix) auricularia* Linnaeus (1758) in Different Localities of Doon Valley

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The present investigation is based on the monthly observations on the occurrence of cercarial infection in the vector snail *Lymnaea (Radix) auricularia* Linnaeus (1758) collected from the following 5 localities namely, Harrawala, Doiwala, Sugar Factory, Jollygrant, Doohlee and Sahaspur of the Doon-Valley between May 1994 to April 1995. It was observed that throughout the year, the snail collection sites were found to differ locality to locality. Likewise, the size distribution of the snail and infection rate also varied site to site. There was less infection among the snails collected from Doiwala Sugar Factory area in comparison to other localities. However, the heavy infection by the cercariae belonging to 3 categories viz. Liver Fluke, Amphistome and Schistosoma were recorded from Harrawala, Jollygrant and Dudhlee.

Accessory Reproductive Glands of the Cattle Fly, *Tabanus triceps* (Thunberg) (Diptera: Tabanidae)

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The female blood sucking Cattlefly, *Tabanus triceps* (Thunberg), common in Tamilnadu, is a reservoir of 21 genera of bacteria and 12 genera of fungi and causes immense loss and havoc directly to cattle and indirectly and directly to man. Control measures requiring thorough knowledge of the biology of this vector revealed the simple reproductive system to have large ovaries and a pair of long, thin, white accessory reproductive glands. The gland, simple in histoarchitecture, exhibits the glandular epithelium supported by muscle and basement membrane. Glyco-lipo-proteinaceous secretion re-

leased by the apocrine, columnar cells, independent of the testis, seems to be utilised for gluing safely the eggpods on vegetation near water.

Effect of Fenbendazole on the Carbohydrate Metabolism of Common Poultry Worm *Ascaridia galli*

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Adult *Ascaridia galli* obtained from the common fowl (*Gallus gallus*) were exposed *in vitro* to 10^{-3} M, 10^{-4} M and 10^{-5} M fenbendazole for 4 to 6 hours at 38°C . 10^{-3} M caused mortality of *A. galli* after an exposure of 6 hours. The effect of the drug was investigated on the homogenates of the treated worms. When the worms were incubated with 10^{-3} M fenbendazole for 4 and 6 hours, the glycogen level was reduced by 71.7% and 86.0%, whereas the lactic acid level increased by 48.5% and 72.0%, respectively. In a period of 4 and 6 hours respectively, glucose uptake was reduced by 64.0% and 73.6% and lactic acid production decreased by 54.7% and 67.0%. The alkaline phosphomonoesterase activity was inhibited by 53.7% and 74.2% in 4 and 6 hours, respectively. The lower concentrations of the drug also affected glycogen and lactic acid level, glucose uptake, lactic acid production and the activity of alkaline phosphomonoesterase to different levels.

Effect of Triclabendazole on the Carbohydrate Metabolism of Common Poultry Worm *Ascaridia galli*

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Adult *Ascaridia galli* obtained from common fowl (*Gallus gallus*) were

exposed *in vitro* to 1% and 0.5% triclabendazole for 5 hours at 38°C. 1% triclabendazole caused mortality of *A. galli* after an exposure of 5 hours whereas 0.5% triclabendazole caused mortality after 7 hours. The effect of the drug was also investigated on the homogenates of the treated worms. When the worms were incubated with 1% triclabendazole for 5 hours the glycogen level reduced by 17.3%. It was supported by concomitant enhancement of lactic acid level by 63.7%. Glucose uptake was reduced by 29.4% and 17.6% with 1% and 0.5% triclabendazole, whereas lactic acid production was decreased by 44.2% and 26.6%, respectively. The alkaline phosphomonoesterase activity was diminished by 57.1% and 36.0%, when treated with 1% and 0.5% triclabendazole, respectively.

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Applying Mixture of *Bacillus sphaericus* and Neem Based Biopesticide to Understand Synergism Against Larvae of *Cx. quinquefasciatus* (Diptera: Culicidae)

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Extensive bioassay trials with mixtures of *Bacillus sphaericus* 1593M and neem based biopesticides were performed to understand independent joint action by synergism against susceptible laboratory colony of *Cx. quinquefasciatus* larvae. The low dose response of toxins from individual giving 10 to 25% mortality were mixed to derive top concentration (0.1 + 0.01 mg/lit of Bs & neem) as the model described by Tabashnik (1992) and thereafter subsequent lower concentrations were placed to trace grades of lethal concentrations. It was observed that the mortality was noticed in all combinations as well as for individual toxins. However, the dose response to derive LC₅₀ and LC₉₀ in mixture were not traced and the percentage mortality obtained was more or less equal to their individual mortality. The results clearly show that independent joint action does not exist in the combination.

The interactions among the toxins of *Bacillus sphaericus* and neem biopesticide against *Cx. quinquefasciatus* resolve an apparent trend that not exceeding the expected percentage mortality to increase the effectiveness of the mixture. So it is difficult to interpret synergism exclusively between toxin interactions by null model proposed. It is worthwhile to point out here that our unpublished report on management of microbial resistance in *Cx. quinquefasciatus* shows excellent results by a high level synergism between the constituents for breaking resistance.

Temporal Variation in the Biting Behaviour of Mosquitoes in the Urban and Rural Areas

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Mosquitoes exhibit three types of biting behaviour namely diurnal, nocturnal and crepuscular. In addition to this, the peak of biting activity occurs among the each type at various times of the day. To prove the existence of temporal variation in the biting activity, systematic study has been carried out during the period (1992-94) in a few selected locations of urban and rural areas by using suitable methods.

The study shows that *Armigeres subalbatus* alone exhibits crepuscular biting behaviour. Mosquitoes belonging to the tribe *Aedini* predominantly exhibit diurnal pattern. Though *Aedes aegypti* and *Aedes albopictus* exhibit diurnal biting behaviour, they show a temporal variation in the occurrence of the peak of activity. Similar observation has also been made among the species of *Culex*. *Cx. quinquefasciatus*, *Cx. gelidus* and *Cx. tritaeniorhynchus* show variation in their peak of activity.

It is obvious from this study that the mosquitoes share the available hosts in the diel cycle without competition by selecting an appropriate time for their peak of activity. This behaviour enables the mosquitoes to avoid the competition among themselves and enhances the proliferation in a given area.

Preliminary Studies on Characterization of Multidrug Resistant Parasite DNA in *Plasmodium yoelii nigeriensis*

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Plasmodium yoelii nigeriensis is a multiple drug resistant strain of rodent malaria which produces 100% mortality in swiss mice. *In vivo* studies have shown that this parasite is fully resistant to 128 mg/kg dose of chloroquine, 128 mg/kg dose of mefloquine, 400 mg/kg of quinine, 128 mg/kg dose of amodiaquine as well as 128 mg/kg dose of mepacrine. DNA of erythrocytic schizont stages were obtained from parasitized mouse. The infected blood was passed through CF-11 column to remove leucocytes and red blood cells were lysed with 0.2% saponin. Then DNA was purified by pronase treatment and phenol extraction. Different restriction endonucleases were used for digestion of DNA, has yielded discrete bands by electrophoresis with ethidium bromide stained agarose gel. This is useful for further studies on mdr-DNA characterization and their comparison with DNA profile of other malaria parasites.

Identification of Major Socioeconomic and Environmental Dimensions of Filariasis: A Case Study

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Filariasis is one of the most important public health problem continues to remain both in urban and rural areas. The population exposed to the risk of infection was 25 million in 1953; 64 million in 1958; 136 million in 1968; 236 million in 1976 and 304 million in 1981. Filariasis is still in a state of challenging task among public health authorities and hence it needs top priority

in its eradication and prevention. A WHO Committee has come out with an estimation of 905 million people exposed to the risk of infection, Lymphatic filariasis is a major public health problem in India and the problem is increasing every year due to total mismanagement of the environment. The present estimate indicates that about 304 million people are living in zones where lymphatic filariasis is endemic, of which 82 million are living in urban areas and the remaining in rural areas. The heavily infected areas are found in Uttarpradesh, Bihar, Andhra Pradesh, Orissa, Tamilnadu, Kerala and Gujarat. In Tamilnadu microfilarial rate is ranged from 1.7 to 4.7 in places like Chidambaram, Vellore, Kumbakonam and Chinglepet.

Research problem & its significance

The present study was an attempt to analyse the spatial distribution of filariasis in Thanjavur District with special reference to Kumbakonam town particularly with reference to spatial distribution of filariasis cases and the interrelationships between the occurrence of cases and socioeconomic, environmental and demographic factors. The study was attempted at micro-level with a view to identify the small endemic foci based on the disease pattern observed in urban areas and also it may be pointed out that only studies at microlevel can throw light on the factors of geogens and pathogens involved in the disease incidence. Hence, the present study attempted to throw light on specific environment and geographical pathology particularly in relation to physical health and related environmental indicators of Kumbakonam town.

Methodology

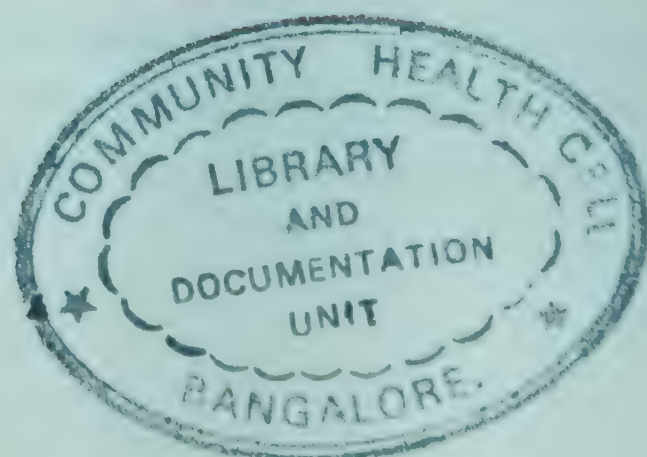
The data collected for the present study were from the filariasis control units of Kumbakonam town and demographic and social particulars were collected from the records of Census Report and Municipal Reports. The collection of primary data includes the particulars related to sex, age, income, health problems and complications, symptoms, environmental sanitation and attitudes and awareness of the disease filariasis. The primary data collection was attempted with the help of a questionnaire survey by direct observation method with the application of scientifically tested random sampling procedure.

The most important tool of analysis for geographers is the cartographic interpretation and analysis of data with the help of quantitative techniques. Other than maps, graphs and suitable statistical techniques were used to analyse the association between filariasis, environment, social, socio-economic and demographic variables. Disease maps form an essential tool for analysing the interrelationships between disease and the associated environmental factors.

Analysis and discussion

Kumbakonam is one of the important religious towns in South India. It is the second biggest town in Thanjavur District. Kumbakonam town extends from $10^{\circ}45'$ North to $10^{\circ}50'$ North latitudinally and from $79^{\circ}23'$ East to $79^{\circ}37'$ East longitudinally. The average density of population of the city is about 11,521 persons/sq.km. The population density varies from one area to another. The highest density of more than 20,000 persons/sq.km is found near the Bus stand, southern and southwestern parts of the city. The mean annual temperature is 32.2°C . and the highest temperature is 38.1°C . noticed in the month of May. Climate in association with topography played an important factor in the epidemiology of filariasis. It influences the breeding of mosquitoes, their longevity and also determines the unlimited growth of the parasites in the insect vector. The maximum prevalence of *quinguefasciatus* was observed during the period when the temperature was between 22°C to 38°C and thus Kumbakonam's town temperature (28 to 38°C) favours the outbreak of filariasis and mosquito breeding (Brunhes, 1969). In addition the relative humidity is also favourable for mosquito breeding and needs a relative humidity of 70%. In addition, the favourable conditions offered by open drainage system in Kumbakonam town with polluted water is yet other promotive factor for mosquito breeding.

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A Comparative Study on Parity Rate of *A. culicifacies* Under the Influence of Lambdacyhalothrin and DDT Residual Spray in Karnataka

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The parity rate and age composition of *A. culicifacies* were observed in two different Districts of Karnataka State, India. The new synthetic pyrethroid insecticide lambdacyhalothrin 10 WP was sprayed @ 15 mg/m² in one PHC of Kolar District and @ 30 mg/m² in another PHC of Tumkur District with 3 rounds and 2 rounds of spray per year respectively during 1991 to 1993. The nearby PHC's selected for comparison purposes were sprayed with DDT @ 1 g/m² with usual 2 rounds per year. *A. culicifacies*, the vector of malaria collected during the study period of 3 years were dissected to determine the age composition. The average parity rate remained zero in the area sprayed with Lambdacyhalothrin 15 mg/m² during all the 3 years. However, in its comparison area which was sprayed with DDT, the parity rate was 21.1% in 1991, 28% in 1992 and 25.6% in 1993. In the area where Lambdacyhalothrin was sprayed @ 30 mg/m², the parity rate was zero in 1991 and 1993 whereas it was 18.3% in 1992. The respective comparison area with DDT spray showed an average parity rate of 71.8% in 1991, 29.2% in 1992 and 22.9% in 1993.

The age grading of the dissected vectors revealed that in DDT sprayed areas of Kolar District, 96 were nulliparous (4-5 days), 33 were uniparous (5-7 days), 18 were biparous (7-9 days) and 3 were triparous (9-11 days). In Tumkur District, 205 *A. culicifacies* were found to be nulliparous, 46 were uniparous, 42 were biparous and only 2 were triparous. In the area sprayed with Lambdacyhalothrin @ 30 mg/m², only 19 were found to be nulliparous, 4 were uniparous and only 2 were biparous. Reduction in longevity in

lamdacyhalothrin sprayed area and even the prevalence of nulliparous vectors to very lesser extent signifies the greater impact of residual spray of these insecticide as compared to DDT.

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eIF-2 Kinase and Protein Synthesis in *Plasmodium falciparum*

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The antimalarial chloroquine acts by inhibiting the parasite protein synthesis *in situ* at therapeutic concentrations. This inhibition of protein synthesis is mediated by autophosphorylation of eIF-2 kinase and phosphorylation of parasite initiation factor eIF-2. Under conditions of inhibition of protein synthesis *in situ* by chloroquine in the culture, the parasite initiation factor eIF-2 is phosphorylated in the parasite lysate to a greater extent than that observed in the control culture. Addition of hemin *in vitro* suppresses this phosphorylation. eIF-2 kinase activity is present in the parasite lysate and is not a contaminant derived from the human erythrocytes used to culture the parasite. It is proposed that the inhibition of protein synthesis of the parasite is an early event mediating the effects of the drug.

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Poly ICLC Mediated Sterile Protection Against Sporozoite Induced Experimental Malaria

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The resurgence of malaria because of widespread emergence of drug resistant strains has necessitated efforts to look for alternate approaches to combat the disease. In pursuance of the earlier reports on interferon gamma mediated prophylactic protection against sporozoite induced rodent and simian malaria infection, we have evaluated efficacy of Poly ICLC, an interferon inducer, against challenge with sporozoites of chloroquine resistant

Plasmodium yoelii nigeriensis in mice and *P. cynomolgi* B in rhesus monkeys. The rodent studies showed that treatment with 5.0 mg/kg of Poly ICLC for 5 days (on days -2, -1, 0, +1, +2) completely protected the mice against higher inoculum though a marginal delay in the development of patency was recorded in different groups. Studies with Poly ICLC at 2.5 mg/kg in 5 dose regimen completely protected the animals against challenge with 1×10^3 sporozoite and provided partial protection against challenge with 1×10^4 sporozoites. Poly ICLC administration for shorter duration of one, two or three doses resulted in partial protection (40-60%) against the infection. This study provides the first evidence of interferon dependent prophylactic protection against *P. yoelii nigeriensis*, a highly virulent murine malaria infection and the inhibition is dependent upon the dose and duration of treatment and sporozoite inoculum. In the *P. cynomolgi* rhesus monkey model, prophylactic treatment with a single dose of 1.0 mg/kg Poly ICLC 18 hrs before sporozoite challenge prevented the establishment of patent infection in experimental monkeys. The inhibitory effect is dose dependent as lower dose provided partial protection. The mechanism of protection is being elucidated.

***Plasmodium* Infection Induced Changes in Protein Pattern in Malaria Vector *Anopheles stephensi* (Culicidae: Diptera)**

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Using SDS-PAGE electrophoretic technique changing pattern of polypeptides in midgut and salivary gland of *A. stephensi* infected with *Plasmodium yoelii*, malaria parasite was studied. A total of 41 and 35 polypeptides were detected in the normal uninfected midgut of 9 and 15 days old mosquitoes respectively. Twelve new polypeptides appeared in the midgut after infected blood meal. Of these four peptides 27 KDa, 34 KDa, 110 KDa and 120 KDa were commonly induced proteins on nine days old midgut (oocysts positive) and 15 days old midgut (sporozoites positive salivary gland). In

addition to above four peptides, six polypeptides, 42 KDa, 100 KDa, 122 KDa, 125 KDa, 138 KDa and 148 KDa were also observed in the midgut on 9th day and two polypeptides (18 KDa and 26 KDa) on 15th day after infection. Interestingly, 23 KDa polypeptides, disappeared from the midgut on ninth day and, 125 KDa, 132 KDa, 135 KDa, 145 KDa, 150 KDa and 158 KDa on 15th day after infected blood meal.

The salivary gland displayed existence of 14 and 18 different polypeptides in normal uninfected mosquitoes (9 day and 15 day old). No newly synthesized protein could be detected in the salivary gland after infected blood meal. On the contrary, many bands disappeared on day 9 (20 KDa and 35 KDa) and on day 15 (34 KDa, 35 KDa, 55 KDa, 57 KDa, 58 KDa, 84 KDa, 90 KDa, 145 KDa, 150 KDa and 158 KDa) after infected blood meal. The developmental changing pattern of polypeptides in the host after parasitic infection and its possible adaptation mechanism will be discussed.

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Species and Sex-Specific Proteins in Mosquitoes

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SDS-PAGE of five species of mosquitoes viz., *An. stephensi*, *An. subpictus*, *Cx. tritaeniorhynchus*, *Cx. quinquefasciatus* and *Ae. aegypti* was carried out in both the sexes. All the five species shows apparent differences in their protein pattern which seems to be sex and species-specific. Eleven polypeptides were common in all the species. Eight polypeptides in genus *Anopheles*, four in *Culex* and five in *Aedes* were exclusively present. 15 KDa protein having carbohydrate moiety was found to be female-specific in all the species. In addition, 12, 13, 17 and 180 KDa female-specific glycoproteins have been suggested to serve as carrier of carbohydrate moiety required during vitellogenesis. Females generally had higher number of polypeptides in comparison to males of their corresponding age. The use of these proteins pattern will be discussed in the taxonomic studies and as well indicating how closely related similar species are.

Effect of r-Hu-IFN- γ and Poly ICLC on Macrophage Activation and DTH Response in Mouse Model After Challenge with *Plasmodium yoelii nigeriensis* Malaria Antigen

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r-Hu-IFN- γ and poly ICLC (an inducer of α , β IFN) are known to exert immunomodulatory action against parasitic infections and exert adjuvant action in experimental vaccination studies with malaria antigen. Recent studies from this institute have shown that both r-Hu-IFN- γ and poly IC:LC are known to provide effective prophylaxis against sporozoite induced *P. cynomolgi* B challenge in rhesus monkeys. The mechanism of action of the cytokines has been explored using macrophage activation and the delayed type hypersensitivity (DTH) response.

In this study, the macrophage activation was recorded by quantitative estimation of colloidal carbon clearance by the activated reticuloendothelial system (RES) in normal mouse and the DTH response was measured by foot pad thickening in mouse challenge with *P. yoelii nigeriensis* antigen. Poly ICLC at 5-25 μ g/20gm mouse (i.p) was found to produce highly significant increased rate of carbon clearance suggesting that this cytokine is able to activate RES system ($p < 0.001$). The RES activation was depressed at 50 μ g and 100 μ g doses of poly IC:LC. The activated macrophages seem to boost the endogenous level of NO which could be responsible for the killing of the sporozoites entering the hepatocytes. The prophylactic activity of the cytokines is mediated by activated macrophages of the RES system. Induction of CMI response can be assayed by positive DTH reaction of the foot pad. Both poly ICLC as well as r-Hu-IFN- γ have been found significantly

increase the foot pad thickness ($p < 0.001$) at doses of 5-25 μg /mouse indicating a positive DTH response following *P. yoelii nigeriensis* antigen challenge (20 μg). DTH response with the cytokines was comparable to that observed with Freund's complete adjuvants in experimental vaccine studies.

The study shows that the cytokines poly ICLC and r-Hu-IFN- γ can generate effective CMI response as evidenced by significant DTH reaction. These studies suggest that these cytokines can be potentially useful adjuvants for vaccination against malaria.

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Immunological Control of Ticks: Identification of Antigenic Epitopes in the Larval Antigen of *Hyalomma anatolicum anatolicum*

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Hyalomma a. anatolicum is one of the most common tick infesting Indian livestock and acts as a vector of bovine tropical theileriosis. Insecticides of different origin are currently used to control this economically important vector. However, widening awareness in the community regarding the harmful consequences to the environment and the hazards of pesticide residues in farm products have stimulated research for the development of alternative control measures. An alternative approach to the control of haematophagous ectoparasites is through vaccination of host with key parasite antigens. As a first step towards the isolation of protective antigen(s), larval extracts of *H. a. anatolicum* was used for the immunisation of rabbits. The antibody response following immunisation was detected by ELISA. Ten days after the last inoculation all the rabbits were challenged with larval and adult ticks and their development and reproductive potential were recorded. The anti-larval antibodies were found protective against the tick as the weight of engorged females and egg masses were reduced significantly as compared with females, fed on controls. Chromatographic purification of antigen yielded three peaks. Of the three peaks, only P_2 showed significant

reaction in ELISA against anti-larval sera. Western blot studies identified specific antigenic epitopes in P_2 and common epitopes in P_2 , nymphal and adult antigens of *H. a. anatolicum*.

Evaluation of F_1 Hybrids Using Newly Evolved Sex-Limited Bivoltine Silkworm Races of *Bombyx mori* L. Three Way Cross II

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Fifteen quantitative characters of F_1 hybrids have been analysed for the first time involving newly evolved Japanese 8618 normal marking, 8608 sex-limited and Chinese 8605 sex-limited varieties of *Bombyx mori* with known genotypes $ZW+p+p$, $ZW+p$ pp females and $ZZ+p+p$, $ZZpp$ males. The quantitative characters of the parents and their hybrids were compared with check variety hybrids currently used in China for Summer and Autumn rearing. These sex-limited races can be disseminated country side for commercial exploitation as supersilkgenious varieties has been discussed.

Mutants of Mulberry Silkworm *Bombyx mori* L

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The domesticated mulberry silkworm *Bombyx mori* L has been the target of scientific study since four decades. Extensive genetic studies have been carried out and more than 320 hereditary traits have so far been analysed. Most of them are related to morphologically recognizable characteristics. These morphological mutants comprise the basic tool for genetic analysis. The present paper deals with different types of larval mutants observed in the breeding programmes and their use in commercial exploitation has been discussed..

CONTRIBUTED PAPERS - POSTERS

An Improved Technique to Prepare Mitotic Chromosomes from Mosquito Larval Neuroblast Cells

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Cytogenetic studies on mosquito species have steadily expanded during the recent years. Several cytological techniques are available for the preparation of mitotic chromosomes of adult as well as embryonic tissue cells belonging to different developmental stages. This paper presents an attempt made to prepare mitotic chromosomes from larval neuroblast cells of mosquitoes belonging to the genera, viz. *Anopheles*, *Culex*, *Aedes* and *Mansonia*, employing the technique adopted for *Drosophila* and Anopheline mosquitoes. This technique which involves pretreatment, fixation and staining has proved equally useful in getting well-spread, well-stained and high frequency of flat somatic metaphase chromosome complements. The slides prepared by this method are found to be useful in rapid screening of chromosomes and can also be handled as air-dried preparations for the application of various banding techniques.

Chromosome Compositional Difference in the Sex-Chromosomes of *Anopheles stephensi*

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The classical C-banding and NOR studies have revealed that in Anopheline mosquito chromosomes extensive heterochromatinization occur over the paracentromeric region of autosomes and most part of sex-chromosomes.

An attempt was made to throw some light on the chromosome morphology in response to *in vivo* effect of some DNA ligands (BrdU, Ethidium bromide,

Acridine Orange, Hoechst and 5-Azacytidine) on the embryonic and larval chromosomes and subsequent staining by appropriate protocols. This report demonstrates the response of mosquito cells to each DNA ligand and to its effect on the structural composition and on the behavioural manifestation of constitutive heterochromatic regions in the genome.

Cytological Characterization of Sex Chromosome of *Anopheles stephensi*

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An attempt was made to provide cytological descriptions of mitotic, meiotic and polytene chromosome organization in the light of several chromosome banding techniques. Attempts were also made to highlight the descriptions of the cytological entities in a chronological manner during the various developmental stages to distinguish between male and female sex. Uses of C- and silver nitrate (NOR) staining have revealed distinct localization and thus identify the exact positions over the heterochromatic compartments. Based on our data, on the chiasmata and terminalization, it is possible to imply that the regions of homology of X- and Y- chromosome during meiosis could be of very short length. It appears obvious that only the distal portions of long arm of X-chromosome represent the euchromatic component corresponding to the polytene X-chromosome since the other portions correspond to heterochromatin which is not involved during polytenization processes.

Synergistic Action of Neem and Clove on the Larvae of Malaria Vector - *Anopheles stephensi*

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A synergistic larvicidal action of neem and clove aqueous extract was observed on the larvae of malaria vector. Significant difference was observed

as compared to the two extracts if used alone. The phenotypic changes were discussed.

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Seasonal Prevalence of Malaria Vectors *Anopheles culicifacies* and *Anopheles stephensi* (Diptera: Culcidae) in Relation to Malaria Transmission.

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The entomological longitudinal study was carried out from January 1990 to December 1991 in Kheri Kalan of Faridabad District (Haryana State). The susceptibility test of malaria vector *An. culicifacies* and *An. stephensi* to DDT 4%, DL 0.4% and Malathion 5% was studied. The mortality in case of 5% Malathion to *An. culicifacies* was 100%. The mortality in case of DDT 4%, DL 5% and Malathion 5% *An. stephensi* was 11.77%, 35.29% and 34.12% respectively. The highest density (7.5) of malaria vector *An. culicifacies* was reported in the village Anangpur. Among the Anophelines, *An. subpictus* was a predominant species (56.89%) and (80.29%) in Badkhal and Anangpur villages respectively.

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Observations on Indoor Biting Behaviour of *Anopheles dirus* in Assam

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An. dirus is a major vector of malaria in North East India particularly in forested hill and foothill regions. Its biting pattern was studied in a forest fringed village of Dibrugarh District, Assam by conducting whole night, indoor human baited collections every month between August 95 - July 96. The biting density of *An. dirus* which was exceedingly low (Man Biting Rate-0) during winter months (December - March) started rising from April

onwards and remained high till October attaining a peak in the month of July (Man Biting Rate - 120). Although biting of *An. dirus* occurred throughout the night its proportion was least (8.1%) in the I quarter (1800-2100 hrs.) Night biting was predominant and uniform during II quarter (2100 - 2400 hrs) and III quarter (00 - 300 hrs) accounting for over 70% biting. Though mean peak biting occurred between 2300 - 2400 hours, the peak biting period appeared to be influenced by the season. During premonsoon months, the peak biting was observed in II quarter of night which was shifted to III quarter in the monsoon months and further to IV quarter in postmonsoon months. While observing the house frequenting behaviour of *An. dirus*, the unfed females were noticed resting in the neighbourhood of the house on vegetation, bamboo fencing or wooden logs etc. indicating that they gather around the house before entering indoor for blood meal. Fed females returned to the forest after leaving the house. Inside the house nearly 20% biting population of *An. dirus* rested on walls for some period before and after feeding, the average indoor resting period being 19 ± 23.5 minutes (range 2-95 minutes).

Changing Scenario in the Repellent Property of the Mosquito Repellents Available in the Market

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Repellents are advocated to build a barrier between the vectors and human in order to minimise the incidence of vector borne diseases like malaria, dengue and brain fever and to reduce the menace of the vicious biting behaviour of mosquitoes. Systematic study has been conducted to screen the efficacy of four repellents against a crepuscular mosquito *Armigeres subalbatus*. Since this mosquito exhibits a predominant peak during the dusk hours, protection time has been worked out during this period.

Repellents containing diethyl toluamide (cream base and lotion); N-N diethyl benzamide (cream); and Dimethyl phthalate, dibutyl phthalate and

terpinol (solution) have been applied on the parts of the legs below the knee and the protection time for each product has been worked out. The time interval in between the time of application and the landing of the first mosquito for biting is recorded as protection time. It varies from product to product. All these products exhibit a very low protection time which ranges from 19 to 54 min. Therefore, it is essential to evolve a new product which will have a longer duration of protection.

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Preferential Resting Habits of a Recognised Malaria Vector *Anopheles stephensi* (Diptera: Culicidae) in Doon-Valley

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The present investigation reveals information on the preferential resting habitats of *An. stephensi*, a recognized malaria vector in Doon Valley. It was observed that during morning hours more mosquito specimens were collected in comparison to evening hours. Maximum mosquito collection was recorded from mixed dwelling that too from thatched houses (TH). Two peaks - one in the month of April and the other one during September - October have been recorded. On the basis of mosquito collected in morning and evening hours a co-relation has been developed. Fully fed specimens were encountered more in indoor resting than outdoor resting.

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Fecundity, Hatchability and Oviposition Rhythms of Sibling Species of the *Anopheles culicifacies* Complex

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Anopheles culicifacies Giles 1901, is one of the most important malaria vector species in India. Based on inversion genotype differences, four sibling species A,B,C and D are identified in the taxon *Anopheles culicifacies*.

Under the laboratory conditions, oviposition in the first gonotrophic cycle was confined to 2000-0800h in all the three sibling species. While species A spread its oviposition more or less throughout the night, species B had a narrow period of egg deposition and in species C, ~75% of the total eggs were deposited between 2200h and 0200h and the rest between 0600 and 0800h. The frequency of egg deposition showed a normal distribution pattern in all the species, although species C showed a certain degree of skewness compared to other two. The total number of eggs produced by the three sibling species in their second gonotrophic cycle under laboratory conditions was significantly different. Egg hatching rates was maximal (70%) and the duration of developmental time was shortest in species C (38+4.5h).

Mosquito Fauna of Doon-Valley

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Survey of the mosquito fauna in all the 30 selected sites, categorised under four complexes i.e. A,B, C and D of Doon Valley in District Dehra Dun was conducted from 6.12.94 to present and adult mosquitoes were collected from Cattle Sheds (CS) Human Dwellings (HD) and Mixed Dwellings (MD) including Forest areas.

The anopheline fauna consisted of 13 species which were included in the following four series:

1. *Myzomyia* Christophers 1924 (*An. acontitus* Doenitz 1902, *An. fluviatilis* James 1902, *An. varuna* Iyengar 1924, *An. minimus* Theobald 1901, *An. culicifacies* Giles 1901), 2. *Neocellia* Christophers 1924 (*An. pulcherrimus* Theobald 1902, *An. stephensi* Liston 1901, *An. maculatus* Theobald 1901, *An. annularis* Van der Wulp 1884, *An. splendidus* Koidzumi

1920), 3. *Pyretophorus* Edwards 1932 (*An. subpictus* Grassi 1899, *An. vagus* Doenitz 1902) and 4. *Christya* Christophers 1924 (*An. hyrcanus* group Reid 1953).

Besides Anopheline mosquito species, other species recorded in the Doon Valley in the present study are *Aedes albolateralis*, *Ae. albopictus*, *Ae. unilineatus*, *Ae. auffuscus*, *Ae. aegypti*, *Culex quinquefasciatus*, *Cx. brevipalpis*, *Cx. vagans*, *Cx. pallidothorax* and *Cx. viridiventer*.

Scanning Electron Microscopic Studies on Mouth Parts of Thirteen Mosquito Species (Diptera: Culicidae) from Punjab & Adjoining Areas

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Scanning electron microscopic studies on the mouth parts of thirteen mosquito species from Punjab and adjoining areas have been conducted to explore additional and reliable taxonomic features for correct and authentic identification of different taxa of these vector species. A few of the species can be easily identified on the basis of conventional taxonomic techniques based on morphological characters and their variations. However, a large number of species difficult to characterize on account of the occurrence of sibling species under definite complexes, sub-species and other component populations showing minor morphological diversification. The recent reports on the existence of biotypes showing different vectorial behaviour in same populations has warranted an immediate need for the recognition for such small taxa in order to establish their true function and for taking adequate control measures against them. In the present studies, thirteen species of common mosquitoes belonging to four genera viz. *Armigeres*, *Aedes*, *Culex* and *Anopheles* have been scanned under scanning electron microscope for the first time in this country.

Some new characters have come to light. For instance, the number and placement of different types of sense organs on the antennae; the number and shape of bulb-shaped organs on the ventral side of fourth palpal seg-

ment of maxillary palps; total number and shape of lateral maxillary teeth. In some of the species there is an additional row of teeth on the inner edges of the maxillae, the mesial teeth and some where the presence or absence of mandibular teeth. These new taxonomic features have not only strengthened the diagnosis of different species but can also be used for separating various species complexes.

Studies on the Behavioural Activity Patterns of Female *Culex quinquefasciatus* Say of American College Campus, Madurai

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Mosquitoes are the world's most important vectors of human diseases and are conspicuous nuisance pests as well. They transmit diseases including dengue fever, yellow fever, malaria, filariasis etc.

The work has been done on *Culex quinquefasciatus* and the biting activity and flight activity showed a nocturnal pattern. A clear klinotactic reaction has been observed in *Culex quinquefasciatus* preferring dry side in the humidity alternatives of 33-100% RH and 0-100% RH. Pink, blue, black and green background were preferred for oviposition rather than a white background.

Lime and eucalyptus extracts were avoided for oviposition when compared to those of onion solution and garlic solution.

The Pupation and Adult Eclosion Rhythm in a Mosquito *Culex quinquefasciatus* Say

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Today mosquitoes have been the subject of enormous interest in behavioural responses. The diseases caused by *Culex quinquefasciatus* are particularly characteristic of Tropical regions.

The informations of the biology and behaviour of the different life stages of the mosquito species are prerequisite for understanding the dynamics of population and elucidating biocontrol potentially.

Pupation and adult eclosion were observed in *Culex quinquefasciatus* during the rainy season. The pupation showed a diurnal rhythm and a nocturnal rhythm was observed in adult eclosion. The peak activity of pupation was observed in between 1300 hrs and 1400 hrs.

The peak activity of adult eclosion during September was between 2200 hrs and 2300 hrs., in October it was between 2000 hrs and 2100 hrs. and in November it was between 1900 hrs and 2000 hrs.

From the above rhythmic patterns, it was observed that it will be helpful in implementing proper control measures of the mosquitoes in relation to the time of emergence.

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Competition Between *Aedes aegypti* and *Aedes albopictus* Larvae in Common Breeding Habitats

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A study on the breeding habitats and larval density of *Aedes aegypti* and *Aedes albopictus* was conducted in Calcutta city for one year during October 1995 to September 1996. Both the species were found separately in rain water collected in earthen, stone, cement, wooden and tin pots distributed randomly in central Calcutta, and in close association with each other in selected earthen and stone pots. Observations on the variation in the larval density of the two species in earthen and stone pots revealed the predominance of *Ae. aegypti* in indoor and *Ae. albopictus* in outdoor pots. The ratio

between *Ae. aegypti* and *Ae. albopictus* larvae in indoor pots was 2:1 in summer and winter and 1:1 in monsoons. The ratio between two species in outdoor pots was however, 1:2 in summer and winter, and 1:3 during monsoons. The data indicates that *Ae. albopictus* though a sylvatic species is trying to establish itself first outdoors and gradually indoors in the city, through competition with *Aedes aegypti*. Both the species have been incriminated as vectors of dengue but the transmission of the disease was localised to the cities till now and the same was attributed to *Ae. aegypti*. The epidemiology of the transmission of dengue is expected to change due to the introduction of *Aedes albopictus* in the city.

Clinical Trials of a New Immunochromatographic Test for the Diagnosis of *Plasmodium falciparum* Malaria in Goa

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Plasmodium falciparum histidine rich protein-2 (PfHRP-2) based immunochromatographic test kit (ICT Malaria P.f.) for the rapid diagnosis of *P. falciparum* malaria was evaluated at the clinic of Malaria Research Centre, Field Station, Goa. Of the 98 febrile patients screened, 22 were ICT positive for *P. falciparum*. Simultaneous microscopic examination of the blood smears of these ICT positive patients showed that 20 were positive for *P. falciparum* alone, whereas 1 had mix infection of both *P. vivax* and *P. falciparum* suggesting sensitivity of 100%. Only 1 slide negative patient who had taken 600 mg chloroquine the previous day was positive in the ICT. Out of the remaining 76 blood smears, 41 showed *P. vivax* infection and none of them cross reacted with *P. falciparum* HRP-2 antigen and were ICT negative except one mixed infection case in which *P. vivax* and *P. falciparum* infections occurred concomitantly suggesting species specificity of 98.7%. The positive predictive value, negative predictive values and efficacy of the ICT

were 95.4%, 100% and 98.9% respectively. The band intensity of the ICT positive cases significantly correlated with *P. falciparum* parasitaemia ($p < 0.01$). The usefulness and the disadvantages of this diagnostic kit have been discussed in the context of prevailing malaria situation in the country.

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Field Evaluation of ICT Test Kit for the Diagnosis of *P. falciparum* Malaria in Assam

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Field evaluation of rapid Immuno-Chromatographic Test kit (ICT, Australia) was conducted among 97 subjects representing various age groups for the diagnosis of *P. falciparum* infection for its sensitivity and specificity. Of these, 85 patients recorded Pf positive by microscopic examination were also confirmed using ICT test kit. Four patients positive for *P. vivax* infection were recorded negative using ICT kit, the remaining 8 patients were negative for malarial parasite by both these methods. ICT kit was noted to be sensitive enough for Pf parasite count as low as 500 per microlitre of blood, however no correlation could be established between parasite density and band intensity of ICT test kit. It was concluded that ICT test kit is cent per-cent sensitive, specific, reliable and fast to detect Pf infections; and it does not cross-react with *P. vivax* antigen.

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Chloroquine Resistance Profile of *Plasmodium falciparum* in Assam, India

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Chloroquine resistance in *P. falciparum* (Pf) malaria parasite was first reported from Manja PHC of District Karbi Anglong, Assam in 1973. Pf moni-

toring team of National Malaria Eradication Programme (NMEP) monitoring the antimalarial drug resistance was studied in 1112 Pf cases in Assam which have been reviewed here. As a whole, Pf was resistant in 47.9% cases, sensitive in 34.2% and SRI type in 17.9%. Among the 47.9% resistant cases 35.7% were of RI type whereas RII and RIII type of resistance were present in 6.5% and 5.8% cases respectively. Geographical distribution pattern revealed that the magnitude of chloroquine resistance was highest in Upper Assam Districts (54.2%) followed by Lower Assam (48.8%) and Hill Districts (44.4%). The degree of overall drug resistance found to be low in areas having high endemicity of malaria and vice versa. However, RII type of resistance was relatively higher in Lower Assam (8.5%) than Upper Assam (5.0%) and Hill Districts (4.8%). Analysis of time trend with 5 years block indicated that increase in RII and RIII cases together was marginal between 1978-82 (15.6%) and 1988-93 (17.3%) but the increase in total resistant cases (RI, RII and RIII together) was substantial i.e. 37.2% (1978-82) and 56.2% (1988-93). Data reflected that the chloroquine resistance of Pf in Assam has yet not been fully stabilized and the chloroquine failure cases at RI level are increasing resulting in higher morbidity due to repeated recrudescence. Possible factors like indiscriminate use of chloroquine by the community and inadequate vector control measures leading to persistent and intensive transmission in precipitating the resistance to Pf have been discussed.

Comparative Drug Susceptibility of *Plasmodium knowlesi* and *Plasmodium falciparum* to Antimalarial Drugs *in vitro*

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Several species of avian, rodent and simian parasites have been used over the years as laboratory models in studies aimed to develop strategies for control of malaria. Long term *in vitro* cultivation of most important human malaria parasite *P. falciparum* has greatly facilitated studies on basic biology and monitoring of drug response. Non-availability of quality human serum which remains an essential pre-requisite for successful cultivation, has hin-

dered a wider use of this parasite in the developing countries. We report successful *in vitro* cultivation of a simian parasite *P. knowlesi* and argue for its application as a model of choice for chemotherapeutic studies. *Plasmodium knowlesi* produces synchronous infection in rhesus monkeys with quotidian periodicity. Short term cultures initiated with ring stage infected cells and cultured in 96 well microtitre plates have been successfully used to obtain dose response curves for reference antimalarials. The culture medium consisted of RPMI-1640 supplemented with 25 mM HEPES, 1% glucose, 0.23% NaCHO₃ and 10% monkey serum. The plates were incubated at 37°C in a candle jar. The relative maturation into schizonts at different concentrations was determined by microscopic observation of Giemsa stained blood smears and analysed to calculate the inhibitory concentrations for each drug. An Indian isolate of *P. falciparum* (FID-3) has also been maintained in long term culture using 10% human serum and inhibitory concentrations for standard antimalarials determined as above. The advantages of *P. knowlesi* as an *in vitro* model for drug assay will be discussed.

Potentiation of Antimalarial Action of Chloroquine *in vivo* by Fluoxetine on a Multidrug Resistant Strain of *Plasmodium yoelii nigeriensis*

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Malaria infection causes more than a million deaths each year, because of the development of drug resistant strains of the human malarial parasite, *Plasmodium falciparum*, there is an urgency to develop new drugs for an effective control of this disease. Identification of novel drugs active against the drug resistant strains or suppression/reversal of drug resistance by using combination of drugs have been the major approach towards this goal.

The effect of reversal agents has so far been demonstrated mostly *in vitro* culture systems. The efficacy of fluoxetine (an atypical antidepressant) as a chloroquine resistance reversal agent against a multi drug resistant strain of

Plasmodium yoelli nigeriensis has been studied *in vivo* in Swiss mice. The mice infected with *P. yoelli nigeriensis* were divided into three groups and were treated with chloroquine (5 mg/kg) and fluoxetine (15 mg/kg) or chloroquine 8mg/kg and fluoxetine 25mg/kg alone respectively. Fluoxetine alone did not cause any suppression in parasitaemia levels or prolong the survival of *P. yoelli nigeriensis* infected mice. However, the combination treatment of fluoxetine and chloroquine resulted in marked decrease in parasitaemia level as well as considerable increase in mean survival time when compared with chloroquine alone. There was significant increase survival of the treated mice to an extent of 85.7% in fluoxetine + chloroquine group compared to 57.1% in chloroquine alone group. The results indicate that this atypical antidepressant potentiates, antimalarial action of chloroquine in MDR strain of *P. yoelii nigeriensis*.

Induction of Nitric Oxide by Murine Macrophages Following Activation with Poly ICLC

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Previous reports from literature show that the interferons are known to activate the macrophages which in turn mediate the synthesis of NO in presence of L-arginine in the hepatocytes which is believed to be responsible for the killing of early E.E. stages of the malaria parasite in the hepatocytes and this action is annuled by the NWNLA. The activated macophages of the healthy mice primed with 5mg/kg dose of Poly ICLC for 5 days, were harvested and cultured in presence of DMEM medium. Macrophages cultured for 8,14,24 and 42 hrs. using 3 methods namely Griess, Rasorcinol and Flurometric for nitric oxide assay were carried out for the sensitivity of the technique.

The peak NO levels were recorded upto 42 hrs, and out of the 3 methods used fluorometeric was found to be most sensitive. Intermediate level was recorded in resorcinol. While the sensitivity of Griess method was low as indicated by the nitric oxide peak.

The NO induced by the cultured macrophage could be inhibited partially by incorporation of NWNLA in the cultured medium used for *in vitro* release of NO from poly ICLC primed macrophages.

The study suggest the possible involvement of cytokines poly ICLC in production of nitric oxide which could be responsible for the damage of the early EE stages developing in the liver, which could explain the prophylactic effect of poly ICLC against sporozoite induced *P. cynomolgi* B infection reported earlier.

Possible Resistant Reversal Effect of Quinidine Against Chloroquine Resistant MDR Strain of *P. yoelii nigeriensis*.

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Quinidine is known to be effective against chloroquine resistant *P. falciparum* at high dose. It was evaluated for possible additive or reversal effect in combination with chloroquin using multiresistant *P. yoelii nigeriensis* rodent strain. For this study the therapeutic treatment was given with quinidine 10 and 25 mg/kg and chloroquine 4 and 8 mg/kg and the results were compared with the combination of quinidine and chloroquine, given orally from day 3 to 6 post infection, when initial parasitaemia was in the range of 2.5%. Analysis of parasitaemia on day 7 post treatment, suggests a significant suppression of parasitaemia when quinidine was given alongwith chloroquine (0.78 ± 0.36). The parasitaemia in chloroquine alone group was 5.75 ± 0.15 , while in quinidine group, the parasitaemia was 0.88 ± 0 . However the mean survival time data revealed that chloroquine group survived for 11.55 days, quinidine group for 11.83 days and the chloroquine-quinidine combination group showed mean survival time of 24.16 ± 9.08 to 27.0 days. There was a significant extension of mean survival time suggesting resistant reversal action of quinidine against chloroquine resistant rodent malaria parasite.

✓ Impact of Deltamethrin Spraying on Malaria Incidence in Coastal Areas of Ramanathapuram District, Tamilnadu, India

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The impact of residual spray of Deltamethrin 2.5% w.d.p @ 20mg/m² was assessed in 6 PHCs of Ramanathapuram District in Tamilnadu State. The two PHCs were in Rameshwaram Island and the rest were in the mainland. The PHCs of the mainland were under malathion spray regularly for more than 10 years. The Deltamethrin spray was done in the years 1995 and 1996. However, Rameshwaram Island was sprayed with Deltamethrin in the year 1991 and 1992 and after a gap of two years again sprayed in 1995 and 1996. The results in both the areas showed significant reduction in malaria incidence. *P. falciparum* incidence also showed a marked reduction.

Implementation of National Malaria Eradication Programme in a Rural Area of Allahabad: Problems and Solutions

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Allahabad District is one of the malaria prone areas in U.P. with a API of > 2. The NMEP has been implemented in the area since 1960. However, the morbidity due to malaria is high and the disease is not under control. This study has made an indepth analysis of the problems encountered in implementation of the programme at a Community Health Centre in Jasra block. A total of twenty five problems were identified. Amongst them six problems

mainly related to, poor skill of the MPW'S making blood films, delayed supply of insecticides, lack of community awareness etc. which were sorted out for immediate remedial measures. Another fifteen problems of more severity such as, lack of leadership of the medical officers, lack of work culture amongst workers, emphasis on Family Planning, poor surveillance, lack of supervision and non-availability of chloroquine etc. were identified, for which an alternative plan of action was evolved to solve them. The details would be discussed during presentation.

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An Exploratory Study of Prevalence of Asymptomatic Malarial Parasitemia in an Endemic Area

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Asymptomatic malarial parasitemia is a new observed phenomenon which has great epidemiological and public health importance. So a population based study was planned to know the magnitude of asymptomatic malarial parasitemia in an endemic area.

The objective was to detect and estimate the prevalence of asymptomatic parasitemia and to know its distribution with relation to certain characteristics.

The estimated prevalence of malarial parasitemia was 25.08 per 1000 population. The estimated prevalence of asymptomatic malarial parasitemia was 18.39 per 1000 population. The prevalence of Pf and Pv asymptomatic parasitemia was 5 per 1000 and 18.3 per 1000 persons. Asymptomatic cases; *Plasmodium falciparum* and *Plasmodium vivax* were 75% and 72% respectively of total cases. Other details would be discussed.

Malaria in Armed Forces Personnel Serving in the North East: A Seven Year Study

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The armed forces personnel serving in the North East have been plagued by malaria for decades. Being a controlled population with proper medical facilities and well recorded health statistics especially morbidity and mortality data, an analysis of seven years of data was carried out by this research worker who had the rich experience of serving both in the army and the air force in the North East from 1990 to 1996.

Army: The army has a large population of above 1.5 lakhs serving in the North Eastern States. Majority of the troops are on suppressive chemoprophylaxis since the 1940's. Overall prevalence of malaria varied from 3.77 per thousand to 6.66 per thousand (1989 to 1995). Prevalence varied in different states from 1.78 per thousand (Sikkim/W.Bengal) to as high as 10.44 per thousand (Tripura/Mizoram/Manipur/Nagaland). In spite of the well organised medical services deaths due to *falciparum* malaria did occur and is a cause for concern. Mortality rate varied from 0.28 per lakh per year to 0.40 per lakh per year.

Air Force: The air force has a population of about 17000 men serving in the North East. Unlike the army the airmen are located at fixed bases and do not move en masse. Prevalence of malaria varied from 4.98 per thousand (1990) to 9.82 per thousand (1995). This was not significantly higher than the overall prevalence of the Indian air force (4.89/1000 in 1990 and 7.79/1000 in 1995). Interestingly, the air force personnel are not on suppressive chemoprophylaxis.

Assam Rifles: (Paramilitary): The Assam rifles have a population of about 52000 serving in the remote and inaccessible areas of the North East. Prevalence of malaria varied from 4.87 per thousand (1991) to as high as 13.62 per thousand (1994) and had a mortality rate three times higher than the army

mostly due to delay in evacuating of patients. These personnel are also on chemoprophylaxis.

These high prevalence rates (though much lower than the rates in civil population) are a cause for concern since all preventive and control measures including chemoprophylaxis have been intensely carried out in the armed forces for decades. Prospects of controlling, let alone eradicating malaria seems therefore to be grim. Therefore, a more realistic epidemiological approach to malaria control would be required.

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Status of Malaria in Calcutta (West Bengal), India

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The area under Calcutta Municipal Corporation is in the grip of malaria, specially *Plasmodium falciparum* infection. In comparison to whole West Bengal, in 1995, Calcutta, "The City of Joy" alone contributed 39.7% of total malaria cases along with 31% *P. falciparum* cases and 36.9% death due to malaria. The incidence of malaria increased nearly two folds in 1995 (Total cases 35394) in comparison to 1993 (Total cases 19084). The *P. falciparum* infection and death due to malaria increased remarkably as 5725 and 52 respectively in 1995 in comparison to 1993 where officially 1802 *P. falciparum* cases with only 3 death due to malaria was recorded. The Above data received from Govt. of West Bengal was not significant because of very poor annual blood examination rate (ABER), which was calculated as 1.5 in 1993, 2.2 in 1994 and 2.9 in 1995. The slide positivity rate (SPR) was noted as 25.6, 21.3 and 28.1 in 1993, 1994 and 1995 respectively.

In order to note the actual magnitude of the disease, monthly fever survey was undertaken in a highly malaria affected ward (Ward no. 84) among 20,000 population between January 1995 to July 1996.

During the study period, a total of 8430 blood slides were examined, of which 4045 (47.9% found positive for malaria infection. Among 4045 malaria

cases 1162 i.e. 28.7% was *P. falciparum* infection. It was found perennial transmission is going on throughout the year. The maximum SPR noted as 69.4% in the month of February 1995 and the lowest 27.5% found in the February 1996.

Drug sensitivity study undertaken during December 1994 and January 1995 against 17 *P. falciparum* malaria cases with 600 mgm chloroquine (Single adult dose) showed 1 (5.8%) case resistant at RII level and 1 (5.8%) case at RIII level. Study with 1500mgm chloroquine (adult dose) during November to December 1995 against 42 cases showed 1 (2.3%) case resistant at RIII level. All 23 cases against Sulfa-Pyrimethamine combination drug showed good response to the drug. The above study was conducted by WHO 7 day *in vivo* technique.

Anopheles stephensi, the vector, was found to breed in a wide range of domestic and peridomestic water collections. The house index, breteau index co-related with malaria incidence in the study area and insecticidal sensitivity status was noted as per WHO methods. The adult mosquitoes were found resistant to DDT and Propoxur, but sensitive to Deltamethrin, Fenthion and Fenitrothion. *A. stephensi* larvae were found resistant to Malathion but susceptible to Fenthion and Fenitrothion.

Malaria Clinic: A Boon in Primary Health Care System

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Malaria constitutes a major threat to health and blocks the path to economical development for individuals, communities and nation. In this circumstance, the Global Malaria Control strategy supports early diagnosis, prompt treatment, implementing selective and sustainable preventive measures and also plans to detect early, so as to contain or prevent epidemics with the local capabilities. To meet these objectives, the Government of India has come out with Malaria Action Programme (MAP). Under this set up, the Primary Health Centre (PHC) is the basic unit and the Medical Officer (M.O.) of the

PHC is responsible for implementation of malaria control activities, in rural areas under the guidance of the District Health Authorities with Entomological back up. As such each Block level PHC has one Malaria Clinic (MC) for screening fever cases, examinations of blood smears for malaria parasite and treatment under PHC system.

In one of the PHCs, in Dharmapuri District of Tamil Nadu State, observation was made over the functioning of the malaria clinic for four years (from 1991 to 1994). The M.O. of PHC referred all fever cases irrespective of the etiology of ailment for blood smear examinations for malaria parasite. A total of 3273, 7498, 6247 and 4781 blood smears were collected and examined in MC during the year 1991, 1992, 1993 and 1994 respectively. The number of malaria cases detected were 205, 515, 353 and 211 for the above years in the order. *Plasmodium vivax* was the predominant species. Treatment to all the cases detected were arranged starting from MC itself i.e. without any time lag between blood collection and case detection. The provisional diagnosis made for all the malaria cases by the M.O. of PHC was perused with the OP nominal register. Only 72.4% against the total malaria cases were diagnosed as PUO, and in the remaining 27.6% malaria co-existed with URI, LRI, Myalgia, Scabies, Viral fever etc. The functioning of MC in PHC, and its relation with malaria control as a boon is discussed.

Sustainable Malaria Control and Environmental Management in Madras

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Malaria is still recognized as one of the most prevalent and debilitating Tropical diseases with nearly 2.1 billion people at risk of infection (WHO 1993). Malaria is a notifiable disease. It is one of the killer diseases of the 1930s which has resurged in the 1970s and 1990s. It is said that malaria has a cycle of occurrence, a peak every seven-nine years. It is highly endemic and incapacitates the people it afflicts. In Tamil Nadu, there has been a shift in the patterns of malaria. This shift is from the foothills to the coastal areas: from Dharmapuri, the Nilgiris and River Pennaiyar to the Coramandel Coast.

Urban malaria has registered 40 - 50,000 cases during 1977-88, whereas the year 1989 has shown a 30% increase. Since 1970, malaria cases have shown significant increase in Madras. These cases accounted for 90 percent of the incidence of urban malaria in the state or 62 percent of the total registered cases (71,517) in 1981. The annual Parasite Index show the rate of occurrence of malaria cases by the Corporation Divisions (wards). High API for 1993 is seen in areas of George Town, Sowcarpet, Seven Wells, Elephant Gate and other Core/Central areas along the beach of the city. It is important to mention that the malaria cases are also concentrated in the core city and the high incidence areas extend towards South and North, but along the coast. The persistence of malaria in Madras city is mainly due to rapid urbanization, migration, environmental deterioration and in sanitation, poorly drained and serviced areas, growth of building/ construction activities, inability to solve the problems of numerous overhead tanks, cisterns & open wells, methodological difficulties, poor reporting and recording of cases in madras city. In this paper an attempt has been made to identify the high risk endemic areas of malaria in Madras city and to highlight the implementation of anti-malarial measures in the city.

Of Malaria , Mosquitoes and Treatment: Past and Present

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The history of malaria dates back to 5th Century BC when Hippocrates differentiated the fever into different types: namely quotidian (daily), tertian (once in 48 hours) and quartan (once in 72 hours) types. Sir Ronald Ross first established the *Anopheles* mosquito malaria relationship and was awarded Nobel Prize in 1902 for the discovery of parasite causing malaria in humans

In human, malaria is caused by *Plasmodium vivax* (benign tertian malaria), *P. falciparum* (malignant tertian malaria), *P. malariae* (quartan malaria) and *P. ovale* (tertian malaria). A little known fifth species, *P. knowlesi*, is also known to cause malaria, but only in Malaysia. The common mosquito vec-

tors of human malaria in India include *Anopheles stephensi*, *A. maculatus*, *A. fluviatilis* and *A. culicifacies*.

In the present paper, the re-emergence of malaria menace in India in recent years, in the backdrop of vector resistance to insecticides and drug resistance in *P. falciparum* to *Chloroquine* and other antimalarial drugs and human resistance to chemical control of vectors has been discussed.

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Comparative Study on the Repellent Activity of Herbal Leaves and Synthetic Repellents Available in the Market Against Mosquitoes

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Repellents are being used widely by people to overcome the nuisance biting behaviour problem and vector-borne diseases. Since mosquitoes exhibit resistance to various repellents, it is essential to look for a potent but a cheaper product to resist their biting by extending the 'protection time'.

Three products containing the following chemicals separately are tested against crepuscular and nocturnal mosquitoes. The tested products are: i) Cream containing diethyl toluamide ii) Cream containing diethyl benzamide iii) Lotion containing diethyl toluamide and iv) Solution containing dimethyl phthalate, dibutyl pthalate and terpinol. The leaf extracts of *Adhatoda* sp., *Ocimum* sp. and *Azadirachta* sp. are also tested similarly to record their protection time against the same mosquitoes. It has been found out that the above four synthetic products exhibit a variation in their repellent property and the leaf crude extracts of these medicinal plants are also capable of showing repellency against the mosquitoes.

Electron Microscopical Studies on the Pathological Effects of *Bacillus thuringiensis* var *israelensis* on *Tabanus triceps* Larval Mid-gut Epithelium

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Tabanids, mechanical vectors, prevalent world over, is a nuisance to man and cattle. Biocontrol of these flies by an entomopathogenic bacteria, for the first time, is reported here. The gram positive, endospore forming, aerobic microbial insecticide, *Bacillus thuringiensis* var *israelensis* produces crystalline toxin- δ endotoxin which disrupts and disintegrates the larval mid-gut epithelium of the cattle-fly *Tabanus triceps*, leading ultimately to its death. Death results from gut lesions and haemolymph ion imbalance, followed by bacterial septicemia. Symptoms of toxic effect commences by 8 hours and by 24 hours the larva dies. The apical region of the cell becomes highly disrupted, nucleus swells and is pushed to the apical end, chromatins are margined, cytoplasm becomes vacuolated and finally the cell bursts. The microvilli, due to the toxin, gradually swells and bursts after 18 hours of treatment. The mitochondrial cristae also swells. The dilated RER cisternae join to form vacuole like spherical bodies, 12 hours after treatment and by 20 hours it becomes a whorl. The margination of clumped chromatin to nuclear membrane gives the nucleus a ring like appearance. Finally the nucleus becomes highly lobulated and is sloughed off. These changes are discussed in the light of the toxic effect of δ -endotoxin.

Susceptibility Status of Vectors of Malaria Filariasis and Japanese Encephalitis in Tumkur and Kolar Districts of Karnataka, India

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Susceptibility tests were carried out on the adults of five mosquito species viz., *Anopheles culicifacies*, *Anopheles annularis*, *Anopheles subpictus*, *Culex quinquefasciatus* and *Culex vishnui* against Labdacyhalothrin 0.1% - a pyrethroid insecticide during the year 1991 to 1993. The vector of malaria *A. culicifacies* was also tested against DDT 4% (An organochlorine insecticide). The results showed that all the species of mosquitoes tested were susceptible to Labdacyhalothrin 0.1%. However, *A. culicifacies* was found to be resistant against DDT 4% as the mortality recorded was 10%. The mortality of *A. culicifacies* against DDT 4% recorded in earlier years was 6.6% in 1985, 5% in 1987, 7.5% in 1988 and 10% in 1990. The susceptibility status of these mosquitoes needs to be verified against dieldrin and malathion which could not be done for want of impregnated papers.

Epidemiological Studies on Bancroftian Filariasis in Human and Vector Population of Raipur City

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Filariasis is one of the major Tropical diseases responsible for considerable amount of morbidity, disfigurement and disability amongst the human population. The disease has a global distribution and an estimated 751 million people live in areas where filarial transmission occurs (W.H.O. 1992). About 1/3 of total world filarial patients live in India alone. This study was planned to assess the prevalence of filarial infection in human and vector population of Raipur city (Lat. $21^{\circ} 14' 14''$ N; Long. $81^{\circ} 38' 5''$ E). 20 μ l finger pricked blood smears collected between 8.00-10.00 pm were examined for microfilariae. A total of 861 (436 males & 425 females) human subjects examined, from six different localities viz., Gudhyari, Fafadih, Rajatalab, Kankali-para, Tikarapara and Budhapara of Raipur, included all age groups i.e., infants, children, adolescent and adults. The prevalence of microfilariaemia was 4.41. The incidence was higher in males (5.50) as compared to females

(3.29). The range of microfilariae varied from 2-7 in males and 1-10 in females. Of the six localities, the highest incidence of infection was recorded in Budhapura (9.28) and lowest in Rajatalab (0.75). Sexwise, in males the incidence was higher in all localities as compared to females. Highest prevalence was observed at Budhapura (11.39) and the lowest in Rajatalab (1.34) in males; whereas higher incidence was recorded in Gudhyari (5.26) and no infection was recorded in Rajatalab in females. When classified in different groups, the percentage of infection was highest in age group 55-60 (33.33) and lowest in 5-10 (1.69). In males, the percentage of infection was highest in age group of 20-25 (16.27) whereas lowest in age group 0-5 (3.57). In female, the percentage of infection was higher in the age group 55-60 (66.66) and lowest in the age group 25-30 (2.5). No infection was recorded in age group 40-45 and > 60 in both sexes. *Culex quinquefasciatus* identified as the vector of *W. bancrofti* at Raipur, was also examined for different stages of the parasite in all the localities along with blood smear study. The total incidence of infection was found to be 4.28. The highest incidence was recorded in Fafadih (7.16) locality followed by Budhapura (5.07).

Toxicity Evaluation of Synthetic and Neem Based Pesticides Against the Filarial Vector Mosquito *Culex quinquefasciatus* and the Brain Fever Vector Mosquito, *Culex tritaeniorhynchus*

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Mosquitoes are still prevailing as the most important vector and they are also considered as a nuisance pest all over the seasons although many attempts have been made to control them; these highly adopted mosquitoes continue to successfully co-exist with man, feeding on him and his domesticated animals. Besides the blood loss, they are also capable of transmitting many diseases. Among several methods attempted to control the vectors, chemical control method seems to be more effective in controlling the mos-

quito population. This is due to its quick action on the vector. Control by conventional method has not been effective in recent times due to the development of behavioural and physiological resistance by the mosquitoes. So, now more reliance is being laid on environmental and biological control. Attempts are still continuing in the search of new compounds which are more effective against target species, safe to non-target organisms and also in cost effective manner. In spite of the search for an alternative, chemical control is depended during the epidemic situation because of its speedy action on vectors.

In the present study, synthetic pesticides and phyto-chemicals are tested for the toxicity against the larvae. LC_{50} values were calculated by using probit analysis. It has been inferred from the study conducted in *Culex quinquefasciatus* and *Culex tritaeniorhynchus* that phytochemicals are as potent as that of synthetic chemicals and in future the organochloride and organophosphates will be replaced predominantly by synthetic pyrethroids and phytochemicals.

Stability of Mosquito Larvicidal Activity of an Indigenous and Highly Potent *Bacillus sphaericus*

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Mosquitoes transmit several important diseases like malaria, filariasis, dengue haemorrhagic fever etc. Their control until the recent past, mainly relied on the use of environmentally hazardous, resistance-development-prone and expensive chemical insecticides. Biological control of mosquitoes, especially with *Bacillus thuringiensis* sub sp. *israeliensis* (Bti) and *B. sphaericus* (strains belonging to serotypes H5a5b) is one of the promising alternatives. One of our strains of *B. sphaericus* (ISPC-8) which has broad spectrum of activity, is highly effective on *Culex fatigans*, a filariasis vector. We had noticed instability in its potency during subculturing though the extent was

relatively less in comparison to our earlier isolates (ISPC-5 & ISPC-6). This attribute has important implications, especially in large scale production of these bacteria where several serial transfers of the culture into fresh medium (subculturing) are involved in the scaling-up process from test tube to a big fermentor. Under laboratory conditions, although ISPC-8 gives rise to non-toxic variants (Str-s Kan-r Ure⁻ Epr⁻ Tox⁻), there is 4-fold increase in the LC₅₀ value against *Culex fatigans* larvae after 12 subculturings. However, the potency of one of its derivatives (MBS-1) remained unchanged and no non-toxic variants bearing the above mentioned phenotype were seen under the same conditions. The toxicity level of MBS-1 was comparable to the most potent strains in commercial use. In view of its enhanced stability this strain appears to be promising for field use.

Influence of Feeding Silkworms with Leaves from Mulberry Plants Grown Under Sewage Water Irrigation on their Growth, Development and Economic Characters of Cocoon

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Irrigational use of sewage water for cultivation of various crops has been practiced for centuries in many countries (Shuval *et al.*, 1986). Direct reusing of municipal and industrial waste water for irrigation is extensively practiced in India. Since the quality of sewage water depends on the nature of the effluents released by the industries and varies with season, there is a need to assess the possible effects on the living system.

The present study was taken up in the villages of Kengeri Technical Service Centre (TSC) near Bangalore. The reason behind this is that Sericulturists of these areas are facing a serious problem of selling their cocoons at Ramanagara Cocoon Market. Their cocoons are either rejected by the

reelers' or fetches less price than the actual market rate. The reelers complaint is that the cocoons of these areas are not yielding continuous silk filament due to too many breakages during reeling. In order to know the exact nature of the complaint, the silkworms of cross breed (PM X NB4D2) were reared in separate batches by feeding the leaves from mulberry gardens irrigated by sewage water (experiment) and the leaves from bore-well water irrigated gardens (control). The study revealed some significant results in the reduction of larval duration by 15 hours during IV & V instars, higher larval weight and in some of the economic characters of cocoon i.e. increase in the cocoon weight, shell weight, cocoon shell ratio (CSR), silk filament length, denier and effective rate of rearing (ERR). These results are discussed in context of beneficial effects of sewage water irrigation.

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Season and Region Specific Problems for Sericulture Extension in the Nilgiris Belt of South India

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The Nilgiris District in Tamil Nadu (S.India) largely comprises the hilly regions of western ghats with complex and fragile eco-system. The average rainfall ranges from 1000 mm to 6000 mm distributed over 180 to 208 rainy days in a year. This region has four clearly identifiable seasons viz.

1. Winter - from December to March with extreme difference between day and night temperatures (5°C - 18°C);
2. South west monsoon rainy season - from April to July;
3. Rainy season with higher humidity & lesser sun-shine - Aug. & Sept.
4. North East monsoon rainy season - during October & November.

The loose nature of soil here is highly acidic with scarce minor elements.

Under the National Sericulture Project (NSP), the CSB and DOS have made

genuine attempts for the flow of technological packages developed to accomplish lab to land transformation with an objective to minimise the gaps from lab based potential to field based realization. However, the uncongenial climate and altitude specific frosting which in turn affects mulberry plantation have made the local sericulturists to abstain from the adoption of recommendations. During the survey carried out in the Nilgiris, more than 90% of the sericulturists preferred to rear the multi-bi hybrids. Added to this the increased labour cost in hilly regions, higher competitiveness from horticultural and plantation crops have led to the poor economic realization of the cocoon crop. Hence, there is an urgent need to organize extension communication with innovative recommendations to popularise high yielding varieties of both mulberry and bivoltine hybrids. The major problems pertaining to extension of mulberry sericulture in the Nilgiris with suggested solutions are discussed.

Effect of Temperature and Leaf Quality on the Larval Growth and Development During Young Age of Silkworm, *Bombyx mori* L

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Silkworm, *Bombyx mori* L, mainly feeds on mulberry leaf and its nutritional status play vital role in growth, development and productivity of the silkworm. The nutritional status (leaf quality) of mulberry leaf vary with the age/leaf maturity. Apart from this, environmental factors such as temperature is known to influence the growth and development of silkworm predominantly. In the present studies, different leaf qualities (viz., tender, medium and coarse) were fed to silkworm at different rearing temperature viz., 28, 30 and 32°C during young age. The synergistic effect of these two factors was found to be different under different combinations, on larval duration, growth rate and biomass accumulation. Increase in leaf maturity combined with higher temperature resulted in drastic reduction in larval duration

growth rate and biomass accumulation. Interaction of leaf quality and temperature on growth of young age silkworm has been discussed.

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Influence of Tukra Infected Mulberry Leaves *Morus alba* on Food Utilization in the Bivoltine Race of Silkworm, *Bombyx Mori* L

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Food intake and utilization patterns were studied in bivoltine (NB₄D₂) silkworm race of *Bombyx mori*. The larvae of NB₄D₂ race were fed *ad libitum* on Tukra (Mealy bug, *Maconellicoccus hirsutus*) infected and normal fresh mulberry leaf *Morus alba* at room temperature $25\pm 1^{\circ}\text{C}$ and $70\pm 10\%$ RH. The larval duration decreased by one day and resulted in lower food intake and faeces defecation. Though the larvae consumed less food, a significant increase in food assimilation and conversion was noticed in the test larvae than in the control larvae. The oxidation of food also decreased significantly. Similarly, the rates of feeding, conversion, assimilation and metabolism decreased significantly in the larvae fed Tukra infected mulberry leaf. However, the assimilation efficiency, gross conversion efficiency (K_1) and net conversion efficiency (K_2) increased significantly in all the test batches when compared with the control. The causative factors responsible for increase in food conversion, conversion efficiencies (K_1 & K_2) and assimilation efficiency with the decrease in food intake in the larvae fed Tukra infected mulberry leaf are discussed.

Effect of Sodium Fluoride on Food and Water Utilization in the Bivoltine Race of Silkworm *Bombyx mori* L, During V Instar

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Sodium fluoride is known for its toxic effects in silkworm and also it affects the crop yield. Dietary food and water intake and their utilization during sodium fluoride treatment in the final instar of bivoltine, NB₄D₂ silkworm race, were studied at recommended environmental conditions. The larvae were fed *ad libitum* on sodium fluoride treated mulberry leaves of *Morus alba* at the concentrations of 25ppm, 50ppm and 75ppm respectively. Daily food and water intake were calculated by standard gravimetric method described by Waldbauer (1968). The larval duration increased significantly by 2 days and food consumption, assimilation, assimilation rate, assimilation efficiency, feeding and metabolic rates increased significantly in all the sodium fluoride treated batches. However, the defaecation, food conversion, conversion rate and conversion efficiencies (K1 and K2) decreased significantly in all the treated batches when compared to the control batch which received untreated fresh leaves. The water intake and utilization parameters increased significantly but, water loss through faeces, rate of water loss through faeces, water retained in the body and retention efficiency decreased enormously in all the sodium fluoride treated batches of silkworms. The causative factors responsible for increased larval duration, food intake and decreased conversion, conversion efficiencies (K1 and K2), water retention, retention efficiency and water loss through faeces are discussed.

Studies on the Non-Ovipositional Behaviour of Inseminated Bivoltine Moths of *Bombyx mori* in Tropics

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Production of quality silkworm seed is one of the major factors that decides the success of silkworm cocoon crop. As hybrids are commercially exploited, the efficiency and the quality of seed production at hybrid level are directly linked with the quality of parental seed cocoons at different multiplication levels viz., P3, P2 and P1. During grainage operations, a significant response is observed in respect of laying realised in relation to the number of laying obtained. Studies were taken up to determine the ovipositional behaviour of inseminated bivoltine moths of *Bombyx mori* in different seasons of the year. The popular bivoltine races viz., NB₄D₂, NB₁₈, KA and another new bivoltine race NP2 were used for the present investigation. The percentage of non oviposited moths after three hours of pairing in NB₄D₂, NB₁₈, KA and NP2 were 17%, 9% , 23% and 14.3% respectively. However, the non-oviposited moths on second pairing laid an average of 274, 212, 143 and 217 eggs for the races respectively. While for the remaining, 450 and above eggs were dispensed. The racial egg laying behaviour in response to different seasons is discussed in the paper.

Effect of Oral Administration of Sodium Fluoride on the Rearing Performance of the Silkworm, *Bombyx Mori* L

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The mulberry silkworm is reported to be very sensitive to the hazardous effect of fluorides. The effect on rearing performance in popular silkworm

ances (NB_4D_2 and $PM \times NB_4D_2$) was investigated by feeding mulberry leaves treated with sodium fluoride at varying concentration (20 to 100ppm). The bivoltine NB_4D_2 silkworm exhibited mortality (during V instar) and survival ranged from 5 to 60% in the treated batches depending upon concentration while the control batches show 70 to 80% survival. The survival percentage showed decreasing trend with increase in concentration of sodium fluoride. The cocoon weights ranged from 1.19 gm to 1.50 gm in treated batches being lower in larvae treated with higher amount of fluoride. Similar observation were made in shell weights in treated batches. In $PM \times NB_4D_2$ silkworms, survival percentage ranged from 8 to 70% after treatment, but control showed 82% survival. The body wt., cocoon wt., shell wt., and shell percentage decreased with increase in concentration of fluoride. The results clearly indicate that sodium fluoride not only induces mortality in silkworms at higher doses, but also decreases cocoon yield even at lower concentrations. The effect on cocoon yield and survival is discussed in relation to the concentration of sodium fluoride.

Persistent Toxicity of Fenvalerate in Mulberry Plant and its Effects on the Silkworm, *Bombyx mori* L

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The commonly used pyrethroid, fenvalerate 20EC, was sprayed on the mulberry plant and its residual effect was studied in two different varieties, namely, bivoltine (NB_4D_2) and multivoltine (pure Mysore), of the silkworm *Bombyx mori* L, LC_{50} of the chemical was obtained with probit analysis during summer and winter seasons in both the varieties. Further, the LT_{50} was calculated for both the varieties during both the seasons. The persistence of chemical in mulberry leaves was studied through residual toxicity in the silkworm larva fed with the sprayed leaves. It was found that both the LC_{50} and LT_{50} of the fenvalerate were affected with the variation in the temperature and that different varieties showed a differential response. The

results are discussed in relation to the effect of fenvalerate on the physiology of silkworm larva.

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Influence of Pupal Weight on Melting and Fecundity in the Silkworm, *Bombyx mori* L

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Melting and fecundity studies in relation to pupal weight were carried out in the two popular bivoltine silkworm races, KA and NB₄D₂. Silkworm seed cocoons raised under the laboratory conditions were used for this study. Healthy male and female pupae were selected, weighed individually and divided into three groups i.e. heavy, medium and light pupae. The female pupal weight ranged from 1.09 to 1.70 gms. in NB₄D₂ and 1.25 to 1.63 gms in KA. Male pupal weight ranged from 0.78 to 1.35 gms in NB₄D₂ and 0.83 to 1.27 gms in KA. Such seed cocoons were preserved under optimum conditions of temperature and relative humidity till emergence. Reciprocal crosses were made between three groups and layings were prepared. After completion of grainage activities melting/emergence defect and fecundity was recorded from the two races. It has been observed that melting/emergence defect was found to be more in light and heavy female pupae compared to medium pupae, whereas, in males it was more in lighter pupae. There was a significant increase in fecundity with the increase in female pupal weight in both the races.

Electrophoretic Studies on Some Nematode Parasites

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Comparative biochemical data supplementing morphological differences in nematodes is taxonomically useful since the taxonomy of various nematodes based on morphological and biometrical characters and host preference have many limitations. Keeping these facts in view, the present investigation was undertaken to find out differences in the protein content and isozyme patterns in case of peroxidases, esterases, acid and alkaline phosphatases in females of *M. incognita* and in males and females of *H. contortus* and *T. globulosa*. The purpose of investigation was to differentiate various nematodes on the basis of these parameters.

All the nematode parasites revealed different peroxidase isoenzyme profiles except the females and males of *H. contortus* and males of *T. globulosa*. Females and males of *T. globulosa* had similar isoenzyme bands at Rf values of 0.69 and females of *M. incognita* and males of *T. globulosa* had similar bands at Rf value of 0.28. In case of esterases, all the nematodes revealed different isoenzyme bands except in females of *T. globulosa* and males of *T. globulosa* and *H. contortus*. Acid phosphatase isoenzyme also revealed differences in all the nematode parasites studied. No alkaline phosphatase activity was detected in females of *H. contortus* and *T. globulosa*, so it was difficult to differentiate between them.

Present studies have revealed the differences in the biochemical composition i.e., in protein content and pattern of isoenzymes of peroxidases, esterases, acid and alkaline phosphatases in various nematodes. These differences could be possible due to species and sex variation, and also due to the adaptation of parasitic nematodes to their hosts.

Physical Modification in the Environment of Pupa and its Consequence on Eclosion in *Pieris brassicae* L (Lepidoptera: Ditrysia: Pieridae)

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The pupae formed under normal conditions showed a consistent suspensor length of 6mm. While in those under physically modified environment, the suspensor length ranged from 3.9 mm to 6 mm.

The pupae which were detected from the site of pupation (minus suspensor) fixed in a petridish, (a) with support showed 0-20% crippling (b) without support showed 80-100% crippling of imago. While in control all imago were fit to fly.

Eclosion is also facilitated by mechanical pressure exerted on the inner surface of the pupal wall, by the out ward curling of imaginal wings.

Two New Species of the Genus *Eudorylaimus* Andrassy 1959 (Dorylaimoidea: Qudsianematidae) from Rohilkhand Division, U.P.

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Two new species of the Genus *Eudorylaimus* viz. *Eudorylaimus bareilliensis* n.sp. and *Eudorylaimus ahmadi* n. sp. collected from the soil found around the roots of *Phaseolus vulgaris* (Bakla) and *Cajanus cajan* (Arhar) have been described from Bareilly (Rohilkhand). *Eudorylaimus bareilliensis* n.sp. is 2.16 mm long with $a = 21.62$, $b = 3.62$, $c = 60.05$, $c' = 0.9$, $V = 15\ 54\ 14$, Odontostyle = 28 μ m and is closely related to *Eudorylaimus obtusicandatus* in lip region length, value of b and V. *Eudorylaimus ahmadi* n. sp. is characterised by $L=1.736$ mm, $a = 24$, $b = 4.0$, $c = 48.9$, $c' = 0.86$, $V = 12\ 54\ 13$, spear = 48 μ m. It is close to *Eudorylaimus granuliferus* in length and value

of 'b'. It however, differs in the shape of the tail, cardiac region and lip region.

Epidemiology of Phthirapteran Ectoparasites Infesting Pigeons

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Prevalence rate and intensity of infestation of four phthirapteran ectoparasites (e.g. *Columbicola columbae*, *Companulotes bidentatus compar*, *Colpocephalum turbinatum* and *Hohorstiella lata*) on the pigeons belonging to Garhwal has been recorded. Impact of host sex, age, feather colour, feather condition and mode of confinement on the prevalence rate has been statistically analysed. The intensity of infestation has been recorded by coding system. Correlation between mean monthly prevalence rate and four ecofactors (temperature, relative humidity, rainfall and photoperiod) will be discussed.

L-Amino acid, Glutamate, Malate and Succinate Dehydrogenases Activities in the Male Accessory Reproductive Gland (ARG) of *Serinetha augur* (Heteroptera: Coreidae) - A Cotton Pest

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Amino acid, glutamate, malate and succinate dehydrogenases (L-AADH, GDH, MDH and SDH) activities were determined in the ARG and fat body of *Serinetha augur* before and after mating. Before mating, all enzymes except GDH show lesser activity in ARG and fat body and whereas, GDH

activity was higher in ARG and fat body after mating compared to before mating. Based on this result, it has been discussed the possible energy pathway in the insect *Serinetha augur* during sperm transfer activities.

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***In vivo* and *in vitro* Evaluation of Organophosphorus Pesticides for their Carcinogenic Potential**

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In vitro microsomal degranulation (values higher than 5% degranulation indicate a potential carcinogen) studies with hepatic microsomes of rats indicate that Monocrotophos (0.57 to 9.09 ppm a.i.) and Phorate (0.13 to 1.09 ppm a.i.) have strong carcinogenic potential. Methyl Parathion (4.54 to 9.09 ppm a.i.) and Quinalphos (22.72 to 45.45 ppm a.i.) lack carcinogenicity potential. However, Phenthoate (45.45 to 181.81 ppm a.i.), Malathion (318.18 to 1272.72 ppm a.i.) and Dimethoate (68.18 to 272.72 ppm a.i.) have carcinogenic potential with higher range concentration of active ingredients of these pesticides.

In vivo microsomal degranulation was studied in liver, kidneys, lungs, testes, spleen, small intestinal mucosa, heart, brain, skeletal muscles, adrenal glands and bone marrow cells of rats, after oral administration of 1/12 LD₅₀, 1/8 LD₅₀ and 1/4 LD₅₀ doses of Malathion for 168 days, 1/8 LD₅₀ dose of Monocrotophos and 1/10 LD₅₀, 1/5 LD₅₀ dose of Phenthoate for 84 days. Different tissues showed different carcinogenic response to the various doses of these pesticides. Malathion appears to be more carcinogenic for bone marrow cells and heart. Phenthoate and Monocrotophos appears to be carcinogenic for liver, bone marrow cells, spleen and kidneys. These differences may be due to binding properties and metabolism of the pesticides will be discussed.

Studies on Peroxidase Isozyme Banding Patterns in Mulberry Genotypes

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The present investigation deals with peroxidase isoenzyme banding patterns in eight mulberry genotypes. Of these varieties, Berhampur local is having five bands where as Sukasakawa, Jakkur local, Mutants, M.R. Mildew, Coonoor-11, Selection-41 and Mysore local have revealed less than 5 bands. The significant changes were observed in banding patterns and in their Rf values. The possible relationship between plant morphology and peroxidase is discussed.

Effect of Gamma Radiation on Pupae of the Uzifly, *Exorista sorbillans* Wied

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Present studies were undertaken with a view to evolve genetic control technique involving SIRM for the Uzifly, *Exorista sorbillans* (Diptera; Tachinidae). Two day old pupae of *E. sorbillans* were gamma irradiated with Co-60 at 300 to 1500 rads. The irradiated male (TM) and female (TF) were allowed to copulate with unirradiated opposite sexes respectively. The irradiated male and females with the same dosage were also intercrossed, in order to evaluate sex specific effects on fecundity and sterility. Significant reduction in fecundity (44%) was recorded at 1100 rads. Complete sterility was observed in the cross 'CF x TM' and 'TF x TM' at 1100 rads. Steady increase in mortality rate was noticed upto 1100 rads. However, cent percent mortality was recorded at 1500 rads. Pupal longevity was normal while adult longevity was drastically reduced to 6.5 and 0.4 days at 1300 and 1500 rads respectively compared to control (12 days).

Genetics of Eri-Silkworm *Philosamia ricini*

Shivashankar M.* and Revansiddaiah H.M.

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The non-mulberry Eri-silkworm *Philosamia ricini* is a multivoltine, domesticated and polyphagous insect, belonging to the Order Lepidoptera and Family Saturniidae. The present paper deals with the isolation of larval colours such as green, yellow, blue, translucent white and larval markings such as dotted white, dotted green, dotted yellow, dotted blue, semi zebra white and semi zebra green mutants. These mutants were separately inbred to obtain pure lines. Utilization of these pure lines in genetic analysis will be discussed.

Role of Deltamethrin Under New Malaria Control Strategy

Babu C.J.

Agro Evo, Mumbai

Malaria is still unabated and sporadic outbreaks are occurring in many States of India and it takes the toll of many human lives. Global malaria control strategy emphasizes the need for selective and sustainable preventive measures and similarly, the recently published operational manual for malaria action programme of NMEP also highlights the need for ending of the transmission of malaria and the elimination of the reservoir of infection. For the above mentioned strategies, there is a need to have a very effective weapon to combat this elusive and dreaded disease. The impact of this new and effective insecticide Deltamethrin is discussed in this paper.

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Towards an Appropriate Malaria Control Strategy: Issues of Concerns and Alternatives for Action

Ravi Narayan

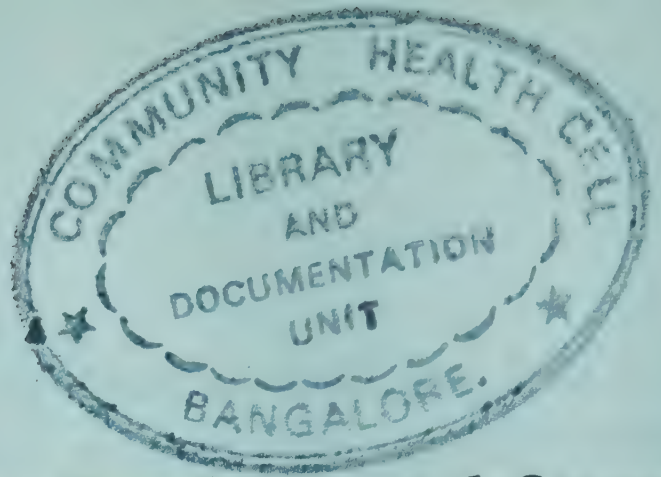
Community Health Cell, Bangalore 560 034

Malaria Expert Group, Voluntary Health Association of India

(Dr. Ravi Narayan, Dr. P.N. Sehgal, Dr. Mira Shiva, Prof. Amitabha Nandy, Dr. Rajaratnam Abel and Dr. Sunil Kaul)

This paper is a summary of the key issues of concern in the present malaria situation in India and the alternatives and complementary strategies for malaria control that need to be initiated to supplement the work of the National Malaria Eradication Programme so that the resurgence of malaria in the country is adequately tackled. These issues and alternatives were identified through an interactive-reflective process which was undertaken by a six member group supported by a large reference group of persons concerned about and or involved in malaria control levels of health care and in different sectors, primarily the voluntary sector.

Among other things, the paper highlights the problem of underestimation of malaria; the need to strengthen the behavioural sciences dimension in planning and research; the challenges of nationalising malaria diagnosis and treatment, including the potential misuse of mefloquin; the alternatives in vector control strategies; and the need to rediscover the community dynamics and dimensions in malaria control including community capacity building, health education, role of voluntary sector, general practitioners and panchayat leadership and the urgency of decentralised planning and the assessment of the role of the ISMs. Policy issues such as health human power development, research, monitoring and forecasting, corruption and political interference, Centre-State responsibility and International public health co-operation are also included.



Proteins and Esterase Isozymes During Developmental Stages of Fenvalerate Resistant Strains in *Anopheles stephensi* Liston

Usha M.H. and Shetty N.J.

Centre for Applied Genetics, Bangalore University 560 056

Vector borne diseases such as malaria, filaria, trypanosomiasis, leishmaniasis pose a major health problem to mankind. *Anopheles stephensi* is one of the principal vectors of malaria. It has developed resistance to various insecticides such as Organophosphorous compound, Carbamate compounds etc.

A strain of *An. stephensi* resistant to fenvalerate with a diagnostic concentration of 10 ppm was synthesised. The proteins and esterase isozymes from *An. stephensi* were analysed by polyacrylamide gel electrophoresis in Fenvalerate resistant strain. Changes in proteins and esterase isozymes pattern during developmental stages were studied.

A few specific protein bands were present especially in the 4th instar larval stage. The proteins and esterase isozyme patterns of Fenvalerate resistance and susceptible strain during developmental stages were compared. The zymogram and relative mobility showed variation in the number and intensity of proteins and esterase bands in the resistant strain as compared to the susceptible strain.

Rational Drug Design - Theory and Practice

Santanu Datta

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With the advent of recombinant DNA technology it is now possible to characterise target molecules (generally an enzyme) of a pathogen which when inhibited results in its death. In our attempt at anti-malarial drug discovery we have characterised the target enzyme Hypoxanthine-Guanine Phosphoribosyl Transferase (Pf HGPRT) of the malarial parasite *Plasmodium falciparum*. This gene encoding Pf HGPRT has been cloned, expressed in

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E. coli and purified to homogeneity. Compared with Human HGPRT the parasite enzyme has unique substrate specificity in its recognition of Xanthine. Thus making Xanthine analogs potential compounds that might specifically inhibit Pf HGPRT. We have developed simple assay based on the functional complementation of the HGPRT gene in *E. coli* that helps us in identifying specific inhibitors. In this presentation the basic steps in rational drug design will be elucidated with major reference to our attempts at identifying specific Pf HGPRT inhibitors.

Nucleic Acid-Based Detection Methods: It's Application in Malaria Diagnosis

Raman K. Roy

Astra Research Centre India, 18th Cross, Malleswaram, Bangalore 560 003

Clinical microbiologists have been traditionally concerned with isolation and identification of pathogenic organisms from humans. Conventional methods involve isolating the organism of interest in pure culture and performing predetermined biochemical and immunological tests to identify it. Development of immunoassays have subsequently improved on the test sensitivity, shorten detection times and improved chances of identifying hard-to-culture microorganisms. Simultaneously, microscopic identification of infectious agents have improved with the development of special/techniques. However, the outlook for even more sensitive, more specific and more rapid testing is currently being founded in the recent advances in molecular biology. Nucleic acid-based technologies have attracted much attention over the past few years in the diagnosis of agents of infectious disease. The advantages of nucleic acid probes in identifying organisms without special or tedious isolation will play an important role in the epidemiology, prevention and treatment of diseases. This will be exemplified by our own work in the development of two DNA-based diagnostic procedures for the detection of *Plasmodium parasites* - one applicable for large scale analysis of field samples for epidemiological analysis, the other being extremely sensitive and relatively faster is suitable for individual diagnosis.

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ಶ್ರೀ ಲಕ್ಷ್ಮಿನಾರಾಯಣ ಕೋ-ಆಪರೇಟಿವ್ ಬ್ಯಾಂಕ್ ಲಿಮಿಟೆಡ್

ನಂ. 1627-2, ಪಾರ್ಕ್ ರಸ್ತೆ, ರಾಮಮೋಹನಪುರಂ, ಬೆಂಗಳೂರು - 560 021

ಆರ್ಥಿಕ ಪ್ರಗತಿಯ ಪಕ್ಷಿನೋಟ

ಸ್ಥಾಪನೆ : 1972

[ತಾ. 31-3-96 ಕ್ಕೆ ಇದ್ದಂತೆ]

[ರೂ. ಲಕ್ಷಗಳಲ್ಲಿ]

1.	ಷೇರು ಬಂಡವಾಳ	:	39.26
2.	ಆಪದ್ಧನ ಮತ್ತು ಇತರೇ ನಿಧಿಗಳು	:	48.06
3.	ರೇವಣಿಗಳು	:	464.72
4.	ಸಾಲಗಳು	:	353.31
5.	ನಿವ್ವಳ ಲಾಭ [1995-96]	:	9.79
6.	ದುಡಿಯುವ ಬಂಡವಾಳ	:	609.27

ಶ್ರೀ ಕೃಷ್ಣೇಗೌಡ : ಅಧ್ಯಕ್ಷರು, ಶ್ರೀ ಕೆ.ಬಿ.ಸಿ.ಗೌಡ : ಉಪಾಧ್ಯಕ್ಷರು,

ಶ್ರೀ ನಂಜೇಗೌಡ : ಖಜಾಂಚಿ, ಶ್ರೀ ಎಲ್.ಜಿ.ಮರಿಯಣ್ಣ ಗೌಡ : ಕಮಿಟಿ ಆಫೀಸರ್

ನಿರ್ದೇಶಕರು : ಸರ್ವಶ್ರೀ ಬಿ.ಅಶೋಕ, ಎಚ್.ಡಿ.ರಾಮಯ್ಯ, ವೆಂಕಟರಾಮಯ್ಯ, ಬಿ.ವಿ.ರಮೇಶ್, ಬಿ.ವಿ.ಪದ್ಮನಾಭಯ್ಯ,
ಕೆ.ಸಂಪಂಗಿರಾಮರಾಜು, ಡಿ.ಅಶೋಕ, ಎ.ಕೇಶವ, ಶ್ರೀಮತಿ ಸುಶೀಲಮ್ಮ, ಶ್ರೀ ನರಸಪ್ಪ : ವ್ಯವಸ್ಥಾಪಕ/ಕಾರ್ಯದರ್ಶಿ

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T.S. Nagaraj

ಹಾರ್ದಿಕ ಶುಭಾಶಯಗಳೊಂದಿಗೆ :

ಸ್ಥಾಪನೆ : 1964

ದೂರವಾಣಿ : 366402

ಶ್ರೀ ಆಂಜನೇಯ ಕೋ-ಆಪರೇಟಿವ್ ಬ್ಯಾಂಕ್ ಲಿಮಿಟೆಡ್

ನಂ.38, ಲಿಂಕ್ ರಸ್ತೆ, ಮಲ್ಲೇಶ್ವರಂ, ಬೆಂಗಳೂರು - 560 003

ಸಂಸ್ಥಾಪಕರು :- ದಿವಂಗತ ಪೂಜ್ಯ ಸನ್ಮಾನ್ಯ ಶ್ರೀ ಸಿದ್ಧವನಹಳ್ಳಿ ಕೃಷ್ಣಶರ್ಮರವರು

ದಿನಾಂಕ : 31-10-1996 ರಲ್ಲಿದ್ದಂತೆ ಬ್ಯಾಂಕಿನ ಆರ್ಥಿಕ ವಿವರಗಳು (ರೂ. ಲಕ್ಷಗಳಲ್ಲಿ)

1. ಷೇರು ಬಂಡವಾಳ	:	50.00	ಭಾರತೀಯ ರಿಜರ್ವ್ ಬ್ಯಾಂಕಿನಿಂದ ಲೈಸೆನ್ಸ್ ಪಡೆಯಲಾಗಿದೆ, ಬ್ಯಾಂಕು ಸ್ವಂತ ಕಟ್ಟಡವನ್ನು ಹೊಂದಿದೆ; ರೇವಣಿಗಳ ಮೇಲೆ ವಾಣಿಜ್ಯ ಬ್ಯಾಂಕುಗಳು ಕೊಡುತ್ತಿರುವ ಬಡ್ಡಿಯ ದರಕ್ಕಿಂತ ಹೆಚ್ಚು ಬಡ್ಡಿಯನ್ನು ಕೊಡಲಾಗುತ್ತದೆ.
2. ವಿಲೇಯಾಗಿರುವ ಷೇರು ಧನ	:	44.19	
3. ಆಪದ್ಧನ ಮತ್ತು ಇತರೇ ನಿಧಿಗಳು	:	31.78	
4. ರೇವಣಿಗಳು	:	321.00	ರೇವಣಿದಾರರ 1,00,000-00 ರೂ.ಗಳ ವರೆಗಿನ ರೇವಣಿ ಮೊತ್ತವು ಡಿಪಾಜಿಟ್ ಇನ್ಸೂರೆನ್ಸ್ ಯೋಜನೆಯಲ್ಲಿ ವಿಮೆಯನ್ನು ಹೊಂದಿರುತ್ತದೆ.
5. ಸಾಲ ಮತ್ತು ಮುಂಗಡಗಳು	:	257.00	ಕೂಡುಹಣ, ಸಂಚಿತ ರೇವಣಿ, ನಗದು ರೇವಣಿ ಪತ್ರ, ಗಡು ರೇವಣಿ, ಉಳಿತಾಯ ಖಾತೆ ಮುಂತಾದ ರೇವಣಿಗಳ ಸೌಲಭ್ಯವಿರುತ್ತದೆ.
6. ದುಡಿಯುವ ಬಂಡವಾಳ	:	346.40	
7. ಆಡಿಟ್ ವಿಂಗಡಣೆ	:	'ಎ' ತರಗತಿ	ಬೆಳಗ್ಗೆ ಮತ್ತು ಸಂಜೆ ಅನುಕೂಲಕರ ವ್ಯವಹಾರ ವೇಳೆ.

ನಿರ್ದೇಶಕ ಮಂಡಳಿ : ಶ್ರೀ ನಂಜಪ್ಪ : ಅಧ್ಯಕ್ಷರು, ಶ್ರೀ ಸಿ.ಲಿಂಗಯ್ಯ : ಉಪಾಧ್ಯಕ್ಷರು, ಶ್ರೀ ಬಿ.ಬಿ.ನಿಂಗಯ್ಯ : ಖಜಾಂಚಿ,

ನಿರ್ದೇಶಕರು : ಸರ್ವಶ್ರೀ ಪಿ.ಆನಂದ, ಬಿ.ಗೋಪಾಲಗೌಡ, ಬಿ.ನರಸಿಂಹಮೂರ್ತಿ, ಬಿ.ಲಕ್ಷ್ಮಣ್ಣ, ಎಂ.ನರಸಿಂಹಮೂರ್ತಿ, ಗೋವಿಂದ, ಹೆಚ್.ಗಂಗಾಧರಯ್ಯ, ಹೆಚ್.ಕೆ.ವೆಂಕಟೇಶ್, ಆರ್.ಸುಬ್ರಮಣಿ, ಶ್ರೀಮತಿ ಟಿ.ಲಕ್ಷ್ಮೀದೇವಿ.

ಹಾರ್ದಿಕ ಶುಭಾಶಯಗಳೊಂದಿಗೆ :

ಸ್ಥಾಪನೆ : 1953

ದೂರವಾಣಿ : 3364609

ಶ್ರೀ ರಾಮ ಕೋ-ಆಪರೇಟಿವ್ ಬ್ಯಾಂಕ್ ಲಿಮಿಟೆಡ್

ತೆಂಗಿನ ಮರದ ರಸ್ತೆ, ಮಲ್ಲೇಶ್ವರಂ, ಬೆಂಗಳೂರು - 560 003

1. ಆಡಿಟ್ ವಿಂಗಡಣೆ	:	'ಎ' ತರಗತಿ	8. ಬ್ಯಾಂಕಿನ ಪ್ರತಿ ಮೃತ ಸದಸ್ಯರ ಕುಟುಂಬಕ್ಕೆ ಸಹಾಯಾರ್ಥವಾಗಿ ಮೂರು ಸಾವಿರ ರೂ.ಗಳನ್ನು ಮರಣೋತ್ತರ ಸಹಾಯ ನಿಧಿಯಾಗಿ ಕೊಡಲಾಗುತ್ತಿದೆ.
2. ಭಾರತೀಯ ರಿಸರ್ವ್ ಬ್ಯಾಂಕ್ ಲೈಸೆನ್ಸ್ ಪಡೆಯಲಾಗಿದೆ. ಬ್ಯಾಂಕಿಗೆ ಸ್ವಂತ ಕಟ್ಟಡವಿದೆ.			9. ಶ್ರೀ ರಾಮ ಪ್ರಿಯದರ್ಶಿನಿ, ಅಮೃತ ನಿಧಿ, ಜೂಬಿಲಿ ಸರ್ಟಿಫಿಕೇಟ್ ನಿಧಿಗಳಿವೆ.
3. 1964ರಲ್ಲಿ ಮೈಸೂರು ಸರ್ಕಾರದಿಂದ ಈ ಬ್ಯಾಂಕನ್ನು ಉತ್ತಮ ಮಾದರಿ ಸಹಕಾರಿ ಬ್ಯಾಂಕು ಎಂದು ಪರಿಗಣಿಸಲ್ಪಟ್ಟು ಬ್ಯಾಂಕಿಗೆ ಪ್ರಶಸ್ತಿ ಪತ್ರ ಮತ್ತು ಪ್ರಶಸ್ತಿ ಶೀಲ್ಡ್ ಕೊಡಲಾಗಿದೆ.			10. ರೇವಣಿದಾರರ ರೇವಣಿಯ ಭದ್ರತೆಗಾಗಿ ರೇವಣಿ ವಿಮೆ ಮಾಡಿಸಲಾಗಿದೆ.
ದಿನಾಂಕ 30-09-1996ಕ್ಕೆ		ರೂ. ಲಕ್ಷಗಳಲ್ಲಿ	11. ರೇವಣಿಗಳ ಮೇಲೆ ವಾಣಿಜ್ಯ ಬ್ಯಾಂಕುಗಳು ಕೊಡುತ್ತಿರುವ ಬಡ್ಡಿಯ ದರಕ್ಕಿಂತ ಹೆಚ್ಚಿನ ಬಡ್ಡಿಯನ್ನು ಕೊಡಲಾಗುತ್ತಿದೆ.
4. ಸಂಗ್ರಹಣೆಯಾದ ಷೇರು ಬಂಡವಾಳ	:	54.13	
5. ಆಪದ್ಧನ ಮತ್ತು ಇತರೇ ನಿಧಿಗಳು	:	46.14	
6. ಸಂಗ್ರಹಣೆಯಾದ ರೇವಣಿಗಳು	:	644.94	
7. ವಿತರಣೆ ಮಾಡಲಾದ ಸಾಲಗಳು	:	574.68	

ಶ್ರೀ ಎಂ.ದೇವಣ್ಣ : ಅಧ್ಯಕ್ಷರು, ಶ್ರೀ ಆರ್.ಬಿ.ಅಣ್ಣಯ್ಯ : ಉಪಾಧ್ಯಕ್ಷರು, ಶ್ರೀ ಸುಬ್ಬಯ್ಯ : ಕಾರ್ಯನಿರ್ವಾಹಕ ನಿರ್ದೇಶಕರು

ಶ್ರೀ ಕೆ.ಜಿ.ಮಂಜುನಾಥ್ : ಗೌ. ಖಜಾಂಚಿ, ಶ್ರೀ ಕೆ.ಜಿ.ವೆಂಕಟೇಶಯ್ಯ : ಕಮಿಟಿ ಆಡಿಟರ್

ನಿರ್ದೇಶಕರು : ಸರ್ವಶ್ರೀ ಎಸ್.ಕೆ.ಕರಿಯಪ್ಪಗೌಡ, ಶಿವಲಿಂಗಯ್ಯ, ಡಿ.ಗಿರಿಗೌಡ, ಡಿ.ಹೆಚ್.ಗೌಡ, ಡಿ.ಕ್ರಿಷ್ಣ, ಎಂ.ಎಂ.ಬೊಮ್ಮೇಗೌಡ, ವಿ.ವೆಂಕಟಪ್ಪ, ಟಿ.ಎನ್.ನರಸಿಂಹಯ್ಯ, ಶ್ರೀಮತಿ ಜಿ.ವಿಜಯಲಕ್ಷ್ಮಿ ಮತ್ತು ಶ್ರೀಮತಿ ಗಂಗಮ್ಮ

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Govt. of Karnataka

Podium Block, V.V.Centre

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- ಆ ದಿವಸವೇ ಸುಲಭವಾಗಿ ಕೆಲಸ ಮಾಡಬಹುದು
- ಹೊಲಿಗೆ ಇಲ್ಲ
- ಲೈಂಗಿಕ ಜೀವನಕ್ಕೆ ಯಾವ ತೊಂದರೆಯೂ ಇಲ್ಲ
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ಹೆಚ್ಚಿನ ಮಾಹಿತಿಗಾಗಿ

ಹೆಚ್ಚುವರಿ ನಿರ್ದೇಶಕರು

(ಕುಟುಂಬ ಕಲ್ಯಾಣ ಮತ್ತು ತಾಯಿ ಮಕ್ಕಳ ಆರೋಗ್ಯ)

ಆರೋಗ್ಯ ಮತ್ತು ಕುಟುಂಬ ಕಲ್ಯಾಣ ಸೇವೆಗಳ ನಿರ್ದೇಶನಾಲಯ

ಆನಂದರಾವ್ ವೃತ್ತ, ಬೆಂಗಳೂರು - 560 009

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ಸ್ಥಾಪನೆ : 1964

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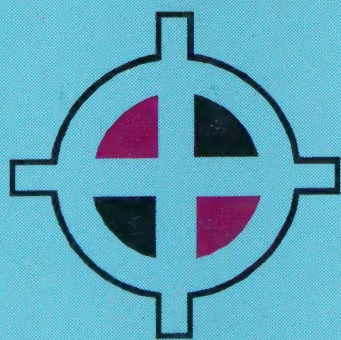
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